ECOLOGY AND SOCIAL FORMATION IN ANCIENT HISTORY

D. K. Bhattacharya

Evolution of a society has been the subject of discussion of almost all social sciences right from the time of Morgan. Unfortunately these discussions have remained locked in the theoretical books on Anthropology. The newer trend displayed in this book 'breaks the doors', as it were, of pure theoretical discussions and enters into the realm of Ecology in order to examine its role in changing the direction, gauging the speed and making the differences in social evolution through newer perspectives.

Cultural Materialism, in the recent years has become the central theme of discussion for the students of Ancient History. The role of ecology in culture for these historians has never been more than just a 'given constant.' The aim of this book is to step out of this material base and go further to examine the role of ecology in determining Social Complexity, Population Density and Technological Intensification in connection with the Prehistoric period.

Rs. 55.00
ISBN 81-7074-054-1

Ecology and Social Formation
in Ancient History

Ecology and Social Formation in Ancient History

D. K. Bhattacharya
Department of Anthropology
University of Delhi

K P Bagchi & Company
CALCUTTA NEW DELHI

First Published in 1990
K P Bagchi & Company
286 B B Ganguli Street, Calcutta 700 012
1-1698 Chittaranjan Park, New Delhi 110019.

The Publication of this book was financially supported by the Indian Council of Historical Research, and the responsibility of the facts stated, opinions expressed or conclusions reached, is entirely that of the Author and the Indian Council of Historical Research accepts no responsibility for them.

ISBN 81-7074-055—X

Printed in India by Ananda Press and Publications Private Limited, Cal-9 and Published by K. K. Bagchi on behalf of K. P. Bagchi & Company. 286, B. B. Ganguli Street, Calcutta 700 012

Dedicated to the memory of

Professor François Bordes

PREFACE

Works on ecology have become so monumental that to add new work requires a justification. Whatever little I could manage to read out of these eminent works makes me feel that man has reached a near panicky stage about, (i) the depletion of natural energy base and (ii) the increase of pollution. Consequently most of these works show preoccupation with these issues. Suggestions to remedy them are also provided but all these suggestions ask man to restrain and rationalize his needs. To me this has been not quite adequate, because we have no possibility of understanling cultural needs and engineer it unless we understand the process of its formation. In this book, therefore, the emphasis is on **Man** and his **Culture** while ecology is considered as an important factor in shaping them. In most of the specialized ecological works the emphasis to me appears to be reversed. I have specially aimed the work for social historians and if they find it useful I would consider my attempt successful. I have borrowed numerous ideas and informations from a variety of sources. I shall like to gratefully acknowledge the authors while a listing of such sources would not be quite practicable. I shall like to record my thanks in particular to Reid A. Bryson and Thomas J. Murry the authors of **Climates of Hunger,** and Evan Hadingham the author of **Secrets of the Ice age** for the inspiration their books provided to me in writing the present work. Finally, I shall like to record my gratitude to Prof. R.S. Sharma who had once seen the first draft of the work and never failed in encouraging me to give it a final shape.

D.K. Bhattacharya

World Environment Day
Delhi-110 007
5th June 1987

CONTENTS

1

Emergence of Man as a Dominant Species

1.1 Introduction

MAN is an animal who belongs to a broad class of mammals with a given number of exceptions which are specific to his species. The characters he shares with the broad group are many. He has a back bone that protects the spinal cord. At the fore end the spinal cord culminates into a concentrated centre of neural tissues in the brain box. The brain serves the purpose of associating two parts of the central nervous system. One of these is the sensory part which carries stimuli from the sense organs, and the other is the motor part which effects muscular reactions to these stimuli. In man this associational system is geared to an optimal functioning which gives rise to the faculty of intelligence. Man has a constant body temperature which is maintained mainly by the brain with the help of the skin and its sweat glands. Fertilization takes place in the body itself and usually results in single birth.

The main feature which separates man from the general mammal groups is his ability to store knowledge. His power of perceiving the actual and projecting it into the thought of the possible distinguishes him as a unique creation. Language and extreme specialization of hands are counted as the natural consequences of the chain of modifications that followed the cerebral development.

1.2 Environment and Early Lifeways

The entire physical and organic world that envelopes man can be described as environment. The inorganic or

the physical environment consists of the earth, its rocks, soil, surface waters and the atmosphere, i.e. its weather and climate. The force of gravitation accounts for the rise of mountain chains, the formation of the ocean basins and also for the erosion of the earth by wind and water. Its laws are fundamental to relase of heat, chemical and atomic energy. The organic world includes plants, insects, birds, animals and men. The only and ultimate source of energy that integrates the elements comes from solar radiation. The plants capture the solar energy first during the process of photosyntheses. A good portion of this is also helped by the soil and water. The life of plants and animals that feed on plants is, therefore, ultimately dependent on the solar energy. No animal is self sustained, if all plants on earth were to die, soon all animals would die as well. The earth as a whole may be considered as a system within which a dynamic equilibrium is working uninterruptedly. The condition of this equilibrium has not always been ideal. If the history of the planet is considered one can find out more than one instance of deviation from the ideal. An ideal equilibrium requires that the number and kind of the animal species are to be constant. It logically follows that the population of each of these species needs to vary interdependently around an established proportion decided by the environment. Secondly, the climatic conditions provide sequences of seasons and weathers in exact repetition of the sequences in which the species have attained an optimum demographic picture. Finally, it is also important that the waste products of the living things along with weathering of rocks provide fertile soil conditions constantly and are not lost from the cycle of mass and energy.

Since organic evolution is a time projected hypothesis, no single scientist can record the past deviations from the ideal equilibrium on an empirical plain. At the most, we can assert that human adaptation is a constant effort to survive in the face of disequilibrium created in parts by man himself and by the acute reversal of seasons. Biologicaly man is as much equipped for adaptation as any other species but his ability to create an additional me-

dium unique to himself makes his adaptations singularly different from other animals. This unique, though tremendously complex medium, is his *culture*. It is important to mark that although man is a part of environment his culture is not. In other words, his action and creation are independent of natural laws.

In order to understand the genesis of this unique medium one has to trace the evolution of man from the early stage when he separated himself from the ancestral stock. There are various dates suggested for this period on the basis of finds from Ethiopia and Kenya. Scientists working on the basis of biochemical indicators have recently proposed (Cronin 1977) a much younger date of the event than what was earlier held on palaeontological ground. A concensus about this date seems to be far off, at least for some time to come. Recently (Tanner, 1981) an attempt has been made to take cognizance of this difference of opinion and provide a new model of human evolution. However, since our main concern here is with the genesis of human culture, we may leave aside the controversy that goes around date. We may safely base our theorizations of culture by careful observation of the life styles of Chimpanzees who seems to be close enough to man in the protein clock.

Of all the non-human primates whose biological features have close resemblance to man, chimpanzees have been found to be specially capable of representing a remarkable number of human behaviours. The most obvious anatomical character that distinguishes these man-like primates from other mammals is their position of head. Unlike quadrupeds the vision range of primates is immensely increased because the eyes are no longer along the spinal cord but are shifted to an almost right-angled position to it. This modification is accompanied by an occasional erect posture. Primates can walk rapidly on their hind legs and their hip bones also have adequate modification to afford agility in walking. In their normal postures the spinal cord makes an angle of 45^0-60^0 to the ground because of their forelimbs which are much longer than the hind legs. They have developed rotatable thumbs which allow them not

only to grasp larger objects but also to manipulate smaller ones between the thumb and other fingers. Their preception of colour and stereoscopic vision are also well developed which enable them to appreciate the relative depth of the various objects within their total vision range.

In average the primates show a marked structural difference between the sexes. While some males weigh well over 70 kg the weight of females may be as low as 40 kg. In chimpanzees this sexual difference is considerably reduced. They have an average life span of 20 years and their full maturity is reached at their eighth year. Births are normally single and the infants are more or less completely dependent on their mothers during the first 1 year from the date of their birth. Interestingly, the baby is not discarded even when the mother delivers a second child. This helps to develop a sibling bond as well.

Primates are generally omnivorous. Fruits, berries and leaves constitute more than 80 per cent of their food. The animal protein is derived from bird eggs and small animals which are killed. They do not share their food with anyone except with a completely dependant infant, who may have to solicit food from the mother first. Their adaptation to varieties of wild forests depend on their range of hair covering and metabolism. They are usually available in regions where the day-time temperature do not fall below 32° Fahrenheit or do not rise above 120° Fahrenheit. They move in groups, seldom exceeding two to three hundred members, within the bounds of 10 to 15 square miles of a territory abuandanly provided with food and water.

Chimpanzees are found in much smaller numbers but on a wider territory. Their habitats vary from lowland rain forest to savanna woodlands in equatorial Africa. During the last two decades a number of studies have been conducted on the behaviour of these chimpanzees in the wild which furnish the main clue to our understanding of culture as an adaptive mechanism for early man. For instance their dietary habit shows a wide subsistence base. Although their movements are restricted to a rather homogeneous ecozone, they consistently exploit as many

as 77 plant species of various orders such as barks, roots, leaves, blossoms, ripe fruits or even the tender stem. Since almost all of them occur on trees the chimpanzees have to adapt themselves to tree life. But adaptation to ground life is necessitated for such activities as the collection of insects, salt licking, drawing water and, finally, the killing of animals. Animals like small monkeys, bush buck or guinea fowls are hunted only when they become easily available without much effort. No special chasing similar to predation has ever been observed. They eat mostly at the place where they collect or kill.

Since primates are poorly equipped to protect themselves against predators, they band together for keeping an all round watch. Their alarm calls on sighting predators are so distinct that even seasoned hunters find them helpful in tracking wild cats on prowl. They have also developed a strictly ranked group-system within the band for survival. The introduction of rank and order within the band requires the functioning of a communication system among the members which is provided by a large array of postures and signs.

Chimpanzees, however, because of their large body size and strong canines, do not require the group protection all the time. Smaller bands of 4-5 individuals are known to go out on their own from the larger band of 30-40 (on an average) and keep foraging for a number of hours. Contact with the original band is kept by periodic hooting exchange. Most of their time, when they are neither foraging nor profecting themselves, is spent in assuring and re-assuring the internal discipline of the group. This is more often achieved or expressed by 'grooming'. It is one of the most important form of social intercourse. In one of the studies conducted on chimpanzees it was found that, out of a total of 290 hours recorded, there were as many as 135 instances of this tactile method of social contact ; while only 30 instances of aggressive threats were recorded during the same period of observation. Friendly behaviour can also be expressed in a variety of ways like gesture, embrace, kiss or the like. Grooming not only assures friendship but indicates that all is well

within the organizational form. The harmony of the group life is hardly disturbed. The sociability among the males is not ruptured in spite of the monopoly of females in rut by an *alpha* male leader at a time. In the event of a conflict conciliation is easily reached by facial expressions or other non verbal means of communication. These are mechanically adopted by the infants through plays by imitating their parents. There is no other specific mechanism by way of which new member can be taught.

Verbal communication is mostly used for expression of impact of the general environment, which may be classified by dividing them into two heads viz., *pain and pleasure*. Thus a chimpanzee may use the same or similar sound to express as wide a range of feelings as fright, tension, territorial possession, annoyance or even to declare dominance (*pain*). Similarly discovery of food, material satisfaction, petting of the younger ones or even declaring subjugation to a dominant leader may all be expressed by another group of similar sound (*pleasure*). All these verbal communication sounds are unable to refer to specific objects in the environment nor can they refer to situations of the past or furture.

The earliest ancestors of man emerged in savanna land. They chose a far more open area than the chimpanzees were used to. Further, all evidences known till date tends to indicate that their population density must have been lesser than that of some of the chimpanzee groups. Since stable sustenance food potentiality of a given *eco-niche* is mainly responsible for controlling population density, it is possible that they included a wider variety of products in their diet at this stage. Osteological and archaeological evidences strongly suggest an increase in non-vegeteranian diet in early man (when compared with the chimpanzees). In terms of ecological food pyramid, inclusion of animal in the diet of early man was a step away from the base which led him on to a position of advantage so far as the growth of his body and longivity of life was concerned. But the early man did not become exclusively carnivorous, he simply included the animals in his diet in addition to his plant food. The use of a more compre-

hensive verbal language in order to integrate co-operative behaviour among the members of the group must have been a consequent development of this change of food habit and group structure. Since intentional teaching is essential for the transmission of cultural behaviour (as opposed to responsive behaviour), we may safely surmise that making of a comprehensive verbal communication system must have been one of the first steps taken by early man towards laying the foundation of modern culture.

Much of man's experiences with his environment could now be expressed and transmitted to the new generation. The accumulated experience became his knowledge which he could constantly draw upon to decide his further course of action. The growth of technology became closely tied up with this expansive field of knowledge and added new ability into him. The domestication of fire, which may have occurred as early as 200,000 years ago. The territorial limit imposed by environment could for the first time be outstripped by successful use of fire. With the availability of fire to warm himself at night, man could intrude upon the cold temperature regions. Since as a species he evolved against a different ecological background his genetic mechanism for adaptation is totally tuned to adapting in this ecological set up. If he could survice in another ecological zone, it was primarily because he could draw on his culture to meet the new situation. Once the adaptation through culture begins, environment gets time to control the genetic make-up. Eventually a new genetic combination emerges. Physiological adaptation, therefore, becomes complete only through the medium of culture.

With the elevation of culture to such a fundamental role in human evolution, success of the species starts depending considerably on it. However, unlike other characteristics in a species culture as a medium is not identical in description to all mankind. Man is the only species in the organic world which adapts through a medium that varies from group to group. There are as many shades of culture available as the number of different ecological setups. Here again, the same ecological *niche* may be tackled

by two divergent human groups in two different manners by way of changing their strategies of survival. As a result two different shades within the same culture are found to arise.

In the social behaviour of early man some important changes already started crystallizing. Mating within the horde continued to perform essentially the same functions as it did before i.e. to guarantee the group life and to enable the continuity of the species. To ensure the reproduction of such a highly complex being as man a biological system of year round sexual desire and female reproductivity had to be evolved. This required the introduction of a 'fore-play', a completely nerve-dominated stimulation process—to make the female receptive for reproduction. Love as a psycho-somatic phenomenon developed in the primitive stage of man. It is not illogical, therefore, to assume that male-female relationship became much closer in early men than in the chimpanzees and that this closeness created the social environment which was conducive to various co-operative group activities. It may be assumed that the sex life of the immediate ancestors of ture human, who led their lives in primitive hordes, was promiscuous. The brain of the emerging human was progressively becoming larger through the process of natural selection. The pelvis bone was also being progressively modified by the same process to afford an efficient bipedalism. As a result of this dual change a stage appeared when the head became too big to come out of the birth canal. Natural selection worked to terminate gestation before the full development of the foetal brain. A human child has less than 50 per cent of its cerebral growth outside the mother's body. The helplessness of a chimpanzee baby has been observed to last almost up to a year after its birth. The early human groups must have had the duration of postnatal care which was more than the chimpanzee and less than the modern man with a difference that now there was no oestrus in the females and they were sexually receptive all round the year.

This change was enough to break the *alpha*-male dominance, and as a result ties between smaller groups be-

came closer. These smaller groups are the prototypes of biological families and are definable in terms of economic production units. To hold such units together a stronger social system needed to be evolved, and all authorities are in agreement that such a social system as the binding force came to the surface as far back as the appearance of the Neanderthals (100,000 years ago). The helplessness of the offspring and the requirement of psychological bonds between reproducing adults went a long way to formalise these early family organizations. These families in all likelihood were based on kinship system by the time man became fullfledged modern in his body structure (36,000 years ago). The pressure to extend the effectiveness of family unit in organizing tasks of production and survival led man to fashion rules of conducts and to the institutionalization of behaviour within members of a family and also between families. Alliance between families and hence rules of endogamy and exogamy are all products of man's urge to seek the stability of a larger group solidarity. This is a significant stage in terms of inner fragmentation without weakening the total group power. It also forms a stage in the process of evolution when man decided parting of ways from the chimpanzee band society. Now the regional groups or band aggregates were obliged to exchange resources and also co-operate in defence in the event of another territorial group invading the region.

A further complication, arising out of the liberation from rut in these small groups, was caused by the fact that females develop sexual maturity at least 5 to 6 years earlier than males. A female becomes fully developed and fit for reproduction during 13th to 15th year of her age, while a male takes 16 to 18 years to develop sufficient strength to provide food by hunting. The entry of males in reproductive phenomena before they are physically grown up to defend the family and fend for its need can weaken the structure of the bigger group. Initiation rites seem to have developed during this period to take care of the newly formed family and social system. The ideological sanction of manhood to the males had to be imparted formally with initiation rites, before they could be counted ready to replace

older males in both responsibilities and privileges. The possibility of incest in these families had been very negligible because the average longivity of man did not exceed 30 years during Upper Palaeolithic period (Angel, 1972). This did not allow much time gap between sexually matured children and healthy individuals of the parental generation.

By the time man established himself as an accomplished hunter he had solved his basic problem of individual and group survival within the framework of his physiological changes. No predator could destory him unless taken by surprise. He had learnt to anticipate a predator and prepare a proper defensive culture. No climatic extreme could destroy him because his cultural repertoire had already introduced the art of building artificial habitation and the method of keeping it warm. His only weak point was that he had still to depend fully on nature for obtaining food and water. His culture, therefore, was highly pressed for stabilizing food procurement with a reasonable security of supply. Herd hunting of one or several species of large animals, instead of persuing individual animals, seems to have been introduced as a strategy along with intensification of search for collecting one or several of the more abundant wild grains, seeds, nuts, fruits and/or roots rather than random collection of edibles. This way of life brought man closer to the plants he lived on and the animals he hunted. He learnt the habitat of the plants, their flowering pattern and the seasons during which their fruits were to be harvested. In the same way he came to learn the behaviour patterns of the animals, the time of their littering, their foraging and migration pattern.

Man increases his knowledge of the biological environment on which his survival depends. His cultural accomplishments are cumulative. In each generation he progresses towards a more secure system of supply. The cultural apparatus, therefore, increasingly become complex along with the progression from a mere grabbing to eat as the chimpanzee does. The complexity is reflected not only in his technological skill but also in the redistribution system to suit the new organizational structure evolved by him. A strict social norm of distribution of the

booty acquired during the course of hunting went a long way in maintaining the security of supply even for those who may not be physically present in the chase of the wild animals. In terms of the part of nature exploited archaelogical evidences show that a very narrow specialization was never aimed at. His choice had always included a reasonably wide base of animals, birds and aquatic fauna. He emerged as the most successful predator himself. He drove out his competitors whenever his security of supply was in danger.

In short, man started dominating the organic community to which he sought adaptation. The extent of his role can be very well demonstrated by an incident in Africa. Contemporary hunters-gatherers in Africa were suddenly excluded from the forests where they had lived from prehistoric times because those forests were declared as Wild Life Reserves. This required radical adjustments in both plant and animal distribution to develop a new balance in the environment free of man (Watson and Watson 1969). Man's power of altering the environment can be quite drastic, but this power does not cause any critical disequilibrium in the organic world till he takes to domestication of plant and animal. As a result of plant domestication ; man became capable of trapping solar energy into the plants which were eaten by him ; while those not eaten were simply eliminated and replaced by some other edible varieties. In the same way, domestication of animals led him to concentrate on the preservation of the animal protein stock for use at convenience.

During the late Palaeolithic and Mesolithic (10,000 to 7,000 B.C.) this change in human culture brought about a gradual increase of sedentariness accompanied by the growth of population. The impact of this change in life ways also increases the chance of interfamilial conflict. For the regulation of interpersonal relationship a strong ideological framework was established. We may call such conglomerates of bands led by a powerful chief a true *tribe*. The tribe sanctioned authority to an individual to regulate the co-ordination of the local groups and kinship units. Usually the individual chosen for the role of the chief was

ascribed with super-natural or magical powers which passed on through unilineal descent. A tribe with a chief at its head could not increase in population, although the growth of population was one of the conditions for its survival. The chief's inability to excercise power over unlimited numbers without the aid of specialized implementation personell acted as a formidable constraint to the population growth. The development of specialization among certain members of the tribe was, therefore, encouraged.

The technological status of the tribe as a whole was considerably changed with the appearance of specialized personnel. The chief became the co-ordinator of the various specialized groups and helped in the redistribution of the products. In addition to the direct producers and few part-tme specialized individuals, the chief required a full time professional to enforce his power and authority over the group. This full time specialist, evolved by human society for the first time in his cultural history is a Priest*. The communities which corresponded to the Late Neolithic archaeological records were characterized by the lack of standing bodies of armed men to serve as law-enforcement specialists. The acquisition of slaves depended on the nature of surplus production and inter tribal warfares. The constant supply of surplus production and the requirement of increasing number of individuals to go into professional specialization gave rise to a series of problems. A potter could no longer meet the demand of the community unless he had specialized individuals to collect fuel for fire or procure and prepare clay for the artisan to work on. In other words, the survival of a truely prosperous Neolithic community is not possible within the organizational framework of chief system. Hence the transformation of the tribal structure into a statehood. Under the new system of statehood the chief depended on a multitiered managerial staff who looked after the conversion of the surplus into wealth to give tangible shape to his power. Progress towards full fledged civilization was possible under this

*The rise of *Priest* as a specialist and priesthood at the beginning of man's cultural history contradicts the popular belief that prostitution is the oldest profession.

new condition. Extreme professional specialization led to the discovery of metal. Trade and military were the two additional wings of the stage which cropped up during this stage. Evidences suggest that in some places it took only 2000 years for a tribal society to be totally transformed into a full fledged urban civilization. The fact that every Neolithic village did not eventually grow into a civilization is an indicator that such transformations were not always simple or unilinear in development.

Further, the role of favourable ecology including large tracts of ferile alluvial soil and navigable rivers in the neighbourhood cannot be overemphasized. The Nile, Euphrates, Tigris and the Indus had each recorded this rapid growth of culture on their banks, whereas the bank of Danube in Europe remained studded with strong tribal villages with chiefdoms until the metal users from farther east took them over. The reasons for this has to be sought in the fact that metal users were already invading Danubian tract through the Agean coasts when the Neolithic villages had started settling in Austrian Region. Yogoslavia and Hungary did see the rise of a strong agricultural society, but the impact of the arrival of powerfully organized pastoral groups from Ukarania was considerably felt by them. As a result of these complex interaction the subsequent developments in these regions could not be profession based.

Since war plays a major role in civilizational growth armed invasion and colonization of distant agricultural communities by powerful tribals is a well-established phenomenon. The colonies are usually held in the form of protectorates, that is agricultural products are collected as levy from them and in exchange military protection in the event of outside invasion is assured. They villages being the primary sources of supplies are usually debarred from developing on their own and the surplus produced by them is regularly drained off to the city. The city in turn, by way of supplying clerks and soldiers prevent the village from its natural transformation into statehood. The example of Ahar-Gilund along the river Banas in Western India may be cited as probably colonies of the Harappans. These villages were mining copper ores, preparing them

and smelting the metal. But their remains do not show any signs of having reached the statehood. The Aharians can be visualized as smelting copper for the swords of their protectors in the city (the Harappans ?) to be used eventually against them. This system of colonization has reached its extreme during the pre-Christian Roman period.

To sum up, man has always tried to get the maximum out of his environment. With the onset of surplus economy man had consciously or unconsciously to enter into the "power proxy" system. The power made him make the majority work and put their surplus at his disposal. This newly developed power concept being limitless in extent could always put tremendous stress on the dynamic equilibrium of the environment. Primarily because of this need to sustain power that man has long surpassed the potential of his basic resources.

1.3 The Environment and Climate

Our planet is surrounded by a thin skin of air with a more or less constant proportion of three main gases. These are oxygen and its compound with carbon and Nitrogen. Solar heat is the only source of energy inflow into the planet from outside. The rest of the things that we find around us are mere combination and recombination effects of the original mass of elements contained in the planet. This includes plants and animals including man and their products. The organic world is maintained by solar rays. The photons with the help of chlorophyll create food in the leaves of the vegetable world and release tons of oxygen and considerable heat in the environment. Animal world breathes this oxygen to assimilate energy and keep the body 'engine' running. Waste and decay release back all the elements that combine to give the plant or animal a body. Since solar rays do not reach every area of the earth in equal intensity, the polar region and the air in contact with this region remain significantly colder than the equatorial region and the air around it. This temperature diffe-

rence of the ground and the air in addition to the under sea volcanoes, results in the birth of weather cycles.

It is important to note at this stage that the activities of all animals including man is so tuned by nature that the delicate balance of production is hardly affected by man's level of survival. In fact, the basic process of production has never been disturbed in spite of the fact that man has been consuming the solar radiation products (oxygen, plants and animals) from the early stages of evolution. The first attempt at meddling with the natural process was made by man when plants, not needed by him, were eliminated and domesticated seeds were planted instead. As a consequence, the solar energy used by a large number of non-edible plants was directed to man's advantage as food. In the like manner, the products of the solar energy were concentrated only in those animals which were domesticated by man. For their safety predators were destroyed and animals left out of domestication were deprived of their shares of vegetable products in which the solar energy was stored. The entire vegetable food world was thus converted by man into animal protein without any risk of animals being lost to him.

In order to do away with uncertainty of food supply man started intensive collection and large-scale game hunting which brought him closer to the species he lived on. Once his food position was stabilized he was again in equilibrium with the organic world.

The question of physical limit to the supply of food did not really occur to him until there was some kind of a stress on him. This stress could be either in the form of a climatic change strong enough to alter the fauna and flora or an increase in the population. Evidences from prehistory rule out any significant growth of human population until about the beginning of metal using period. Since there are evidences, that progress towards increasing specialization in food procurement was made by man the stress may be traced to the environment. The various glacial spasms, the variation of temperature within the glacial periods and their effects on various latitudes of our planet are very little understood even today. Even Palaeo-

climatic reconstruction methods are not adequate enough for correctly following subtler environmental changes. It is, only with the aid of logic that we can surmize that the increasing specialization in prehistoric technology is a reflection of environmental stress combined with the increase in population density within a given ecological zone. Population growth need not act as stress so long as there is a normal flow of population into fresh eco-zones. It is the increase of density of population which is directly linked with the optimal food potentiality of the area (carrying capacity). The kind and nature of weather changes substantially affecting the organic environment can be understood only when historic evidences of these subtler changes and their results are known. Further, a basic understanding of the weather process can go a great length in explaining change in human habit and culture.

One of the keys to the understanding of the weather process on earth lies in proper comprehension of the phenomenon usually referred to as *Westerlies*. It has been found that there is always a strong circulation of air above the two poles. Though velocity of this flow is strongest at a height of 35,000 feet, it can be felt at ground level as well. The course followed by this jet stream envelopes the entire temperate zone of the globe in a circular manner from the west to the east. Since the circle traced by by westerlies often take loops over one area or the other, the flow at these areas is felt as a current from north to south or the reverse. Observations indicate that they maintain a specific course for a number of years. A slight change of this course is known to have caused a great deal of change in our climate. It is explained that the westerlies are caused by a combination of effects of temperature variation in the various layers of atmosphere combined with the variation of the same at various latitudes. The main reason, however, seems to be the rotation of the planet. The earth makes a full round on its titled axis once in 24 hours. This motion includes the atmosphere above the land surface. Since the circumference of the earth is 25000 miles, the rotational motion at the equator is as much as 1000 miles per hour. This motion starts slowing down

as it turns towards either of the poles. The land surface at the equator does not feel air moving with it, but as soon as the air enters the northern or the southern latitudes, its velocity becomes perceptable because of temperature difference and the slower rotational motion of the surface. Due to the motion of earth which is from west to east, these areas experience a wind current hitting from the west. Hence the name Westerlies. The natural topography of the surface of the earth prevents the Westerlies from being perfectly circular. It has always been observed to move in a loop form. The lowest edge of the westerlies never go lower than 30^0-40^0 south latitude. During less temperature difference between the poles and the equator, these westerlies take to almost a ring shape and shift as far north as 50^0-52^0 latitude (Fig. 1). There is every reason to believe that these westerlies behaved in this manner during the pleistocene period. The total climatic effects of these shifts from such early periods are not reconstructable. Brayson and Murray (1977) have brought out an excellent summary of climatic changes and their effects on human culture of the last 1000 years. Evidences, both literary and archaeological, have been cited to demonstrate the degree to which changes of westerlies can influence the climate as acutely as to transform human culture.

The Mycenean civilization of Greece, which flourished on the basis of a system dominated by trade and commerce and which met its end between B.C. 1200-1230 is taken up by Brayson and Murray (1977) as an instance. They closely demonstrate with a series of well knit presentation of arguments how, due mainly to the shift of climatic belt around the period such a prosperous community as Myceneans disappeared from the face of the world. The records of invasion and settlement of the Scandinavain colonizers first in Iceland and then in Greenland provide information of climate on a more empirical level. From accounts of the settlers and navigators, who sighted ice floats near the island, Berthorsson (1969) developed a temperature curve for north Atlantic region. He observed that if ice was sighted for a total period of

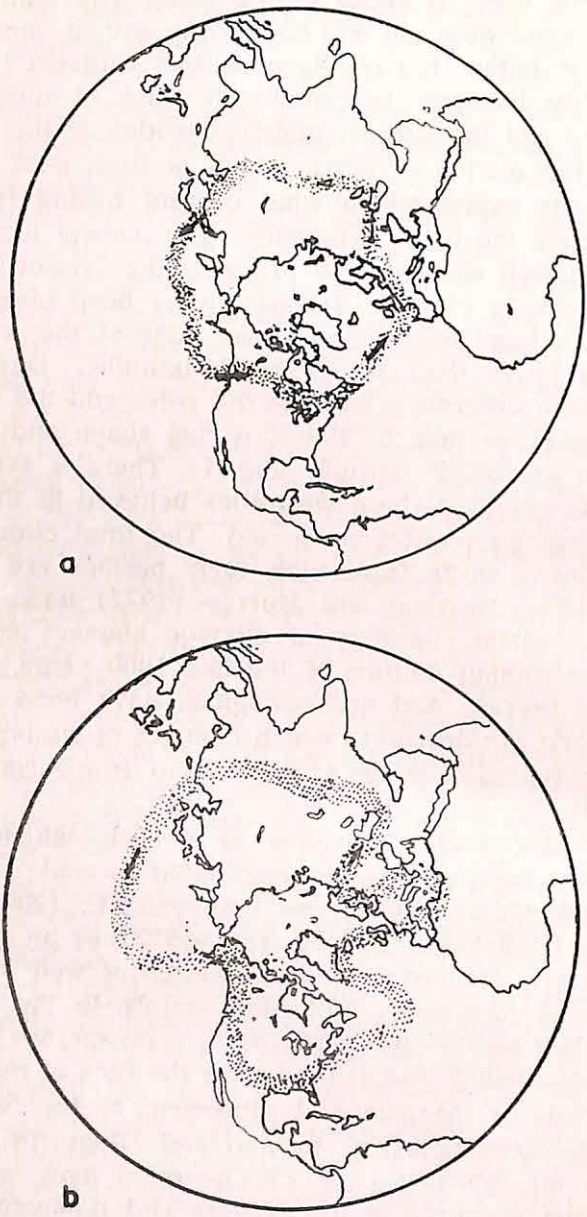

Fig. 1

a. In Summer the course of the Westerlies over the Northern Hemisphere. It contracts to almost a tight circle.
b. In Winter the course of the Westerlies expand to a large looped circle.

20 months in 10 years and for 22 months in the next 10 years then the average temperature of the second decade would be 1°C lower than the first decade. A close look at the graph which is based on the above observation shows (Fig. 2) that there was a steep fall in the Icelandic tem-

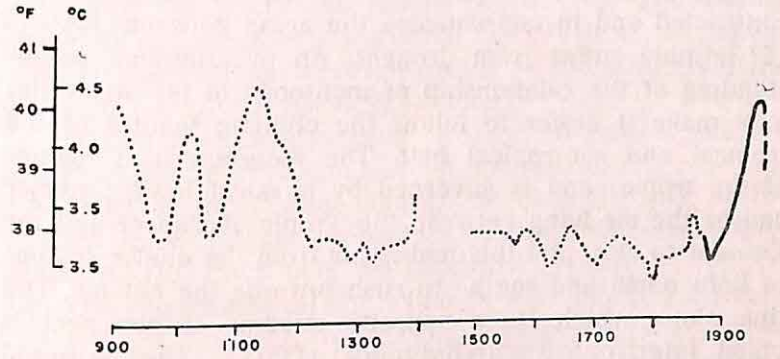

Fig. 2

The Icelandic temperature curve estimated for the past thousand years. The dotted line represents Bergthorsson's estimation while the continuous line represents the temperature recorded since thermometer was invented. The steep fluctuations seen during the 12th and 20th Century might hold key to many changes in human cultural history.

perature during the entire latter half of the 12th century. The effect of this cooling down of temperature near the arctic had caused considerable expansion of the course of the westerlies, followed by severe droughts in one area and ffoods in several areas. Due to these natural calamities English vineyards were ruined; prosperous Palae Indian settlements went into extinction and finally the Viking colonies in Greenland were wiped out. It is not only the Arctic settlements which were affected by the cooling down of temperature. Large-scale devastations all around the globe as a result of temperature fall almost from A.D. 1300 to the beginning of A.D. 1900 are on record. Two glaring instances are : (a) the sudden collapse of a great West African Empire at Mali round about the year 1800; and (b) the great Emperor Akbar's abandonment of his new capital at Fatehpur Sikri during 1570 due to water scarcity immediately on the completion of its construction. The acute coldness, nicknamed as 'little Ice

Age', which was experienced by many a region in Europe and North America during this period is another instance not to be belittled. From the description it may be surmised that expansion of the westerlies creates extreme cold climate in temperate region and the condition of shifting of rain towards the equator. That is, the monsoon belt contracted and in consequence the areas petween 30^0 and 15^0 latitude suffer from drought. An oversimplied understanding of the relationship of monsoons to the westerlies may make it easier to follow the climatic feature of the tropical and subtropical belt. The monsoon is a feature of the tropics and is governed by physical laws. Summer causes the air lying between the Tropic of Cancer and the Equator to rise, and this makes air from the colder regions of both north and south to rush towards the hot air. The line along which these opposite streams of air meet is caled *Intertropical Discontinuity* (ITD). The seasonal movement of the ITD determines the direction of winds. Monsoon represents one of these wind patterns. In summer the land areas closer to sea receive the cooler air from ocean surface. This air (laden with moistures) rises on reaching the ITD, and hence cools down further and releases the water. The land area lying between the ITD and the sea, therefore receives heavy summer rains better known as monsoon. In winter the ITD shifts to the Tropic of Capricorn and hence rain is brought to areas like North Australia and Mexico. The ITD never penetrates the boundary of the westerlies, in fact strong wind activitiy is created in the fixed gap lying between the ITD and the periphery of the westerlies. This clockwise wind cyclone area creates deserts on the regions below. Since expansion of westerlies takes place only when the temperature differences of the poles and the equator are at maximum, it is only natural that excessive cold season in the temperate region will be followed by a shifting of monsoon to further south for the northern hemisphere and to further north in the southern hemisphere (in December-January). This causes a monsoon failure in most of the 18^0-22^0 zone. We have already seen how during A.D. 1300-A.D. 1899 this zone was affected. In India the situation is slightly better

than Africa because of the Himalayas providing a barrier of almost half the height of our atmosphere. It is important, that the westerlies shift to the north of the Himalayas so that the penetration of monsoon in the northern plains becomes possible. The extent and time of this shift are very crucial to successful raising of the crop. The usually observed course of the westerlies lies north of the Himalayas in the summer, and it expands to the southern periphery of the Himalayas in the winter.

During Pleistocene period we can therefore, imagine many a time more fluctuation of the westerlies. During most part of the Glacial stages, the northern and northwestern India did not probably experience the same acuteness of climate which the Glaciated regions of Europe did. The relationship of the Pluvials with the ITD fluctuation has not yet been worked out and therefore a proper understanding of our Pleistocene climate has to be entirely based on the geo-morphological features of the alluvial deposits for the time being.

For the Holocene period, however, more and more evidences have accumulated in recent years to demonstrate that such climatic shifts may explain the zenith and also the nadir of urban development of the Indus valley and beyond. The degree to which a culture can be directly affected by change of climate depends mainly on the technology of the community and its social structure. A palaeolithic community would perhaps have totally perished if the savanna land was suddenly to turn into a desert. The fate of a better equipped community will be much less severe. Unfortunately even technologically better equipped communities turn themselves into such overspecialized states that they make themselves stand in a delicate balance with nature. The latter group has the advantage of control and choice of alternate strategies of adaptation. If what has been recorded in the last 1000 years is not unique, it can be surmised that medium-to-acute microzones of both drought and wet climate have been experienced by early civilizations for a repeated number of periods. It may not be entirely baseless to hypothesize that even the first adaptation to ground from the earlier ar-

boreal existence may have been caused by one of these long-staying climatic extremes during the onset of Basal Pleistocene (about 3-4 million years ago). Likewise, the first step taken by the Neanderthals towards northern latitude during the last glaciation may have also been triggered by a similar change of climate. Every such demand for newer adaptation was met by addition of resource base. For this newer technologies had to be improvised and experimented finally leading to altogether new inventions. Addition of the resources base is a slower change that comes with the equally slow climatic change. The situation becomes reverse when the stress on subsistence is caused by a change in population density. Intensification of the resource base become the main operative urge in this case. This intensification, in contradistinction to extensification in earlier case, may increasingly lead the subsistence to more and more precarious stage. In the prehistoric period either kind of stress had to be remedied through cultural means. Migration or birth controls may have helped to maintain the stress within survival limits. The demand for new technology and invention in the case of population stress remains as much as the same in case of climatic stress. Progression of technological specialization is the maximum an archaeologist can decipher, but the quality of this change can be additional help in discriminating the stress pattern that triggers off these changes. If one-climatic change enabled man to become a terrestrial and bipedal animal, the nature of his subsequent creations would seem to fall mainly along the same line, viz. to enable his now free hands to perform more variety of functions. The harnessing of organic elasticity in order to concentrate force at a point without additional muscular effort is a shift in this line of technological growth. Bows and arrows are, therefore, more of an evidence of intensifying the resource base rather than extending it. That the Palaeolithic hunters-gatherers had included birds and fishes in their diets is amply demonstrated by the Solutrean eyed needles in France and also by the fish vertebrea recovered from Upper Palaeolithic cultural debris. It is only during the Epi-Palaeolithic and Mesolithic age that spe-

cial techniques are evolved towards intensifying a specific aspect of the available resource base. It is important at this stage to mark that alternatives can be provided only when the process of extending the resource base precedes intensification. In other words climatic spasms (which encourages resource extension) has always played a very significant role in deciding the pathways that men have chosen in the subsequent period.

By now we are quite in tune to understand how important ecology is to man and his culture. Further, we also know that the adapted methods can survive as group behaviour only when these are blended with the social structure of the community, that is, the sensory information received by man from the environment is consciously interpreted by him and adopted as a group behaviour. A solitary solution of the stress can never give birth to culture. If each individual developes his own solution, then group behaviour becomes non-existent, and the basic purpose of group life (mainly for defence) is weakened. A socialized solution, therefore, has to be very rigidly enforced to the members of the community. In the present day context the entire penal system can serve as an example of such an application of culture. In the prehistoric society a complex belief system may have been erected for this purpose. Archaeological indications of such a possibility are not altogether wanting from as early a period as 200,000 years from today.

In the following chapters we shall examine if archaeological studies can help us to demonstrate the relation of culture to ecology through time.

2

Foundations of Archaeology

Ecological role in explaining human culture has been pointed out by environmentalists from as early as the last century. Their views, however, did not have a smooth go for a long time until prehistorians started emphasizing the role of ecology on more substantial ground. What the archaeologist aims at for the past societies is something which cannot be excavated. Nobody has dug up a political system, a set of religious beliefs or people's attitude towards their ancestor. Yet all these behavioural patterns when knitted together form the culture of the society and this is what an archaeologist would ideally like to reconstruct. The patterning which the archaeologist perceives in his material is a reflection of the patterning of the culture which produced it.

This basic assumption in the methodology of archaeological studies has introduced a great deal of scope for theorization. First, all remains on a living floor may not have to be linked with learnt behaviour, and may in all likelihood include a great deal of work of novices or things worked or broken just for the fun of it. Therefore, what the archaeologist is actually looking for are those objects which hav been identically fashioned in a large number and are found more or less in identical contexts. Such objects alone can be taken as products of culture. The following analogy may drive the point home if a grandfather of Bison-horn-Maria (a tribe in India) makes his head gear in a particular way and teaches to succeeding generations the need of a headgear, the technique of its manufacture and the role of it in a man's life (in Maria society), then only this item will be identically repeated

through generations and hence qualify itself as a product of culture. Here again once cultural products are identified and isolated in archaeology we have hardly any method of demonstrating the social role of these objects. So the archaeologist has no option but to label various cultures on the basis of the features of the recovered objects and then look for the structural changes in them through time and space. This is the nearest he can approach to cutural evolution and regional variation or dispersal of culture. For the very early periods these remains have been so few that most of them seem to reflect only aspects of the subsistence economy and fail to relate to other spheres of activities. For younger periods, however, the situation appears to be is far more encouraging. The archaeologist, as such, faces the big question of distinguishing between 'activity' and 'ethnicity'. This question has been adequately framed by late Prof. K.C. Chang (Chang, 1967) :

(1) Is it possible and fruitful to reconstruct culture and history by classifying artifacts without recognizing or satisfactorily demonstrating cultural behaviour.

(2) Is there a recognizable logical and casual relationship between the physical properties and contexts of the artefacts and their relevance to the behavioural and cognitive systems of the makers and users.

The answer to both these questions were not sought satisfactorily or even overtly till as late as the fifth decade of this century. Archaeological discoveries made during this period advanced towards standardising techniques of classification or developing reliable local chronologies to strengthen the worldwide applicable chronometer. A group of achaeologists in the New World, during this period, went into explaining pre-Columbian archaeology with extensive use of ethnology. Their explanations were possible because of the unique situation in the Americas where tribal settlements were found almost vertically developing out of ancestral pre-Columbian prehistoric period. Explanations of many enigmatic objects found through excavation could be successfully sought within the total cultural context

from the living tribal society. This development led to a strong interdependence of ethnology and archaeology. It was soon realized that ethnography presented a synchronic aspect of a dynamic process—the evolution of culture which was like a still photograph of a horse in the process of racing; and hence the process, though apparent from such a still, could not really be demonstrated. Archaeology provides the time dimension to this process and thus demonstrates the dynamism empirically. Likewise ethnology could successfully demonstrate the role of the artefacts, recovered through a dig within the total culture. Although universalization of such an interdependence was subsequently highly debated, in American context this exercise led to a vigorous involvement of specialists with culture studies. A new goal of achieving causal explanations of cultural similarities and differences became more important. This search for causal factors to explain cultural process has required developing newer concepts in archaeology. Ecological approach in explaining culture, which was earlier discarded by the structuralists, came into prominence as a new concept at this juncture.

Julian H. Steward, an anthropologist from Illinois, developed his ecological concept for explaining cultures of hunting bands (1936). The concept was further to demonstrate relationship of settlement patterns and ecology of the Western Pueblo (1937). Finally in his famous work entitled *Theory of Culture Change* which was brought out in 1955, Steward tried to develop the methodology for 'determining regularities of form, function and process which recur cross culturally among societies found in different cultural areas'. As against the unlinear evolutionists, who postulated that all human societies passed through similar developmental stages, Steward proposed a multilinear evolution as the basic assumption. Alfred Kroeber, Lewis Morgan and Leslie White had earlier conceived of culture as a 'layered cake' technology being the bottom layer, social organization in the middle and ideology forming the top layer. Steward added environment to the cake and also demonstrated how culture changed in the process of adaptation of the environment. Steward

called the environment relevant to human culture as *Cultural Ecology,* and further added that this phenomenon led to similar adaptation in other cultures with similar environment. This, in other words, was meant to suggest that the cross-cultural similarities were functional. The main thesis of Steward was that cultural ecological adaptations constituted a creative process and this he used both as a research problem and also as a method of interpretation. Studying any group of phehistoric assemblage was, therefore, like looking at the product of a whole system. i.e. the creative process that led to human adaptation included the ideological and sociological sphere of man as much as it did his involvement in basic interaction with the physical environment for subsistence. This assumption would rule out the possibility of simpler technologies being labelled as crude or low, because what was more important was to look for the need of this simple technology as being more suitable for the social and ideological frame of the group. Conversely speaking, advanced technologies, even if known to a group, may not be suitable for answering the demands of the non-economic spheres of life and hence may be rejected. This view contrasted with most of the prehistorians working in Europe. Their idea about culture was more often based on artefacts only. Environment, although considered all along, was merely to provide the scenic backdrop. The excellent work of J.G.D. Clark (1972) on his Star Carr excavation demonstrates one of the best ecological reconstructions of early Holocene settlement. But his work is devoted to reconstruction of economic aspects only. There is no doubt that Julian Steward pushed archaeological studies of our century to the threshold of a great theoretical change.

If we can view culture as a system composcd of interrelated parts, each part helping to maintain the cohesiveness and integrity of the whole and the whole functioning to supply the needs of the organisms, then archaeological data may be divided under three different subsystems. These are *technofacts, sociofacts* and *ideofacts* (Binford, 1965). The objects which are used directly to combat the physical environment may be counted as technofacts,

those used for social function as sociofacts, and finally the objects which have their function in the ideological plain may be counted as ideofacts. The interplay of these three subsystems becomes progressively complex as a socio-cultural system increases its population and also areas of activities. Of these cultural subsystems the one which is most directly tuned to the ability to exploit the environment is technology. Hence it can be safely assumed that technology determines efficiency to a great extent. The strategy chosen to employ technology, social organization and ideological set-up to enforce social norms are the factors which adjust themselves to technological level. Further, it is held that any particular technology subsystem has an optimum corresponding social and ideological level for a given ecological setting. This, in brief, is the stand taken by the proponents of *Cultural Materialism*. It can be clearly seen that this view is not altogether new but had broadly been the basis of Karl Marx's analysis of cultural development and was further elaborated by anthropologists like V. Gordon Childe and Leslie White.

Culture ecology attempts to explain the role of ecology in more explicit terms. The main argument of the cultural ecologists is that no technological system exists in vacuum but rather is more or less adapted to a set of environmental conditions. Hence any change in these conditions is likely to be reflected in a corresponding adjustment in the technology and eventually in the remainder of the subsystems. This argument needs to be differentiated from the much maligned view of environmental determinism held earlier. The cultural ecological approach proposes that the portion of the environmental whole that directly affects culture is itself determined by the quality of cultural technology. Thus, there can be profound changes. We also know that technology is one subsystem of culture which changes rapidly. The value of such a change becomes quickly apparent and is accepted or rejected accordingly. In contradistinction to this, social organization and the ideological force reinforcing it are remarkably slow and reluctant to change. Thus, the dynamic equilibrium set up by these three subsystems often suffers from

disharmonious instability when technology is borrowed and thrust artificially into a society. Most of the Afro-Asian countries in the post-war period started experiencing this phenomenon and continues to do so in a lesser or greater degree. What causes the change in technology under normal conditions ? When a culture strives to make a more efficient exploitation of the unchanged environment, then the change that occurs in technology may be designated as internal change. There is, however, a simultaneous strain put on the environment because of this internal change which may result into overexploitation of games or deforestation to a dangerous limit and so on. This change in environment may reach such a critical stage as to demand a fresh adjustment of technology to suit the new situation. The latter kind of change in technology may be called external change. These two changing processes are simultaneous and are very difficult to be isolated from one another. An example from our modern world may suitably explain the phenomenon of external versus internal change. Pollutants from technological advancement is so changing the ecology that the entire culture, a product of an ecology that no longer exists, must adjust constantly to a situation of its own making.

If the role of ecology is so significant in determining cultural system and their constant adjustments and readjustments to the surroundings, its importance for an archaeologist needs no over emphasis. It was the prehistorians working with cultures through time that utilized the concept of cultural ecology most meaningfully. For a social anthropologist cultural ecology offers very little attraction even today, as the kind of problems in their hand are more suitably explained with structure-function model. It has not only been widely used by archaeologists in their analysis of past cultures but has also been made an attractive theoretical premise for explanation of cultural systems. The archaeologist approaching his data from cultural ecological standpoint must collect all evidences of past environments (ecofacts) of the culture under study. The study of ancient pollens collected from around the site indicates the plants that were present which in turn largely deter-

mined the sorts of animals existing at that time. The tolerance limit of these plants gives clues as to the climate. Surveys for additional contemporaneous archaeological sites may also point to the presence of other competing cultural systems in the area. The need of the latter data as an ecological factor which is often overlooked may have been of utmost importance.

Using these and other techniques it is possible to reconstruct in part the natural and social environment of a past culture. Then by examining artefacts which indicate the nature of the technology subsystem the archaeologist can determine which component of the total environment or econiche was considered for exploitation by the culture. This determination will, then, show which aspects of the environment will affect the culture system most directly through external change. If such a change can be isolated, its corresponding effects on the culture can be charted through changes in technofacts, sociofacts and ideofacts. Studies in pre-Columbian archaeology cuducted in the above manner has laid out the most pivotal hypothesis of cultural ecology. This proves that cultural systems are adapted for exploiting particular portions of their environment through the use of certain technologies, and the form of a culture is in large part determined by ecological conditions to which it is adjusted. When culture becomes more specialized for exploiting a certain econiche, it makes itself peculiarly sensitive to changes in that part of the environmental whole. An external change affecting that part of the environment, even of seemingly minor degree, may have drastic implications for a cultural system. Some of the major civilizations of Middle America apparently faced this crisis about two thousand years ago. Richard Stockton MacNeish (1971) surveyed an ecological zone in the Tehuacan valley of central Mexico to understand the beginning of food production in that area. Twelve stratified sites with 138 superimposed floors were excavated. A long cultural sequence from 10,000 B.C. to A.D. 1520 could be established by this painstaking work. For this, some 10,000 artefacts, 5000,000 potsherds and 50,000 ecofacts were studied from these habitation floors. The

study concluded that the Tihuacans were established in an urbanized area of nearly 25 sq. km. Their population was estimated to be around 75,000. They were highly specialized in growing corn, beans and squash through irrigation of the otherwise semi-arid valley. Its proficiency was such that several thousand individuals were released from direct food acquisition work and hence could become full time professionals like artisans, architects, priests, traders and soldiers. For nearly 600 years this culture remained dominant and flourished in the valley. But this entire cultural superstructure was resting on a base provided by agricultural technology. This adjustment to a particular substance source became more and more precarious as the technology became more specialized for irrigated bottom land in the valley. At the height of its eflorescence, about A.D. 650 a slight oscillation in the amount of water flowing into the fields or in the soil fertility itself may have reduced the margins of agricultural surplus. The result was the collapse of the elaborate structure of the civilization. The site was then occupied by the 'Chichimecs' hunters and gatherers from the northern desert lands.

Some of the small Latin American countries having multiple devevlopment projects, based on the technology of only banana or coffee plantation and the export of these products, run a similar risk in future unless they can expand their technology to include much wider spectrum of their environment for food exploitation.

A functional analysis of archaeologically retrieved objects within the context of the total culture forms the main foundation of archaeology. Additional significance of archaeologically retrieved objects within the context of the total culture forms the main foundation of archaeology. Additional significance of archaeological approach is developed by the theories and behaviours of the various facts of culture. In the following pages we shall briefly examine some of these important facets which combine to contribute to culture.

3

Population and Archaeology

The efficiency and success of a culture is expressed in population growth. In archaeology, therefore, any indication of increase in the population in a past habitation settlement is taken to indicate the success of cultural adaptation within the given econiche. However, since man's reproductive capacity far exceeds the limit of being supported by available food supply, there is always a biological competition between one another for necessities of life. Culture tries to dampen this competition by providing alternate strategies of survival. Technology, on the other hand, strives hard to meet the renewed demands. Inspite of the potentialities of culture to release additional pressure, a stage is reached when famine, war or similar phenomena break out to lower the population. Most acrhaeological thinking has been dominated by the above Malthusian notion (1895), i.e. land and other resources as well as technology set up a limit to population growth. In 1965, Ester Boserup developed the thesis that population growth should be treated as a determining variable for studying technological and cultural changes. Ultimately Boserup's thesis purports that when a population grows more people per land unit are faced with the necessity of being provided with more food per land unit. This has to be done by intensifying their relationship with land and technology. In other words, one might visualize a steady progression from hunting-gathering through stages of cultivation with ever shorter fallow period, and finally to the stage of intensification of multi-cropping with no fallowing. Boserup argues that cultivators do not intensify their agricultural methods or adopt technological innovations except when

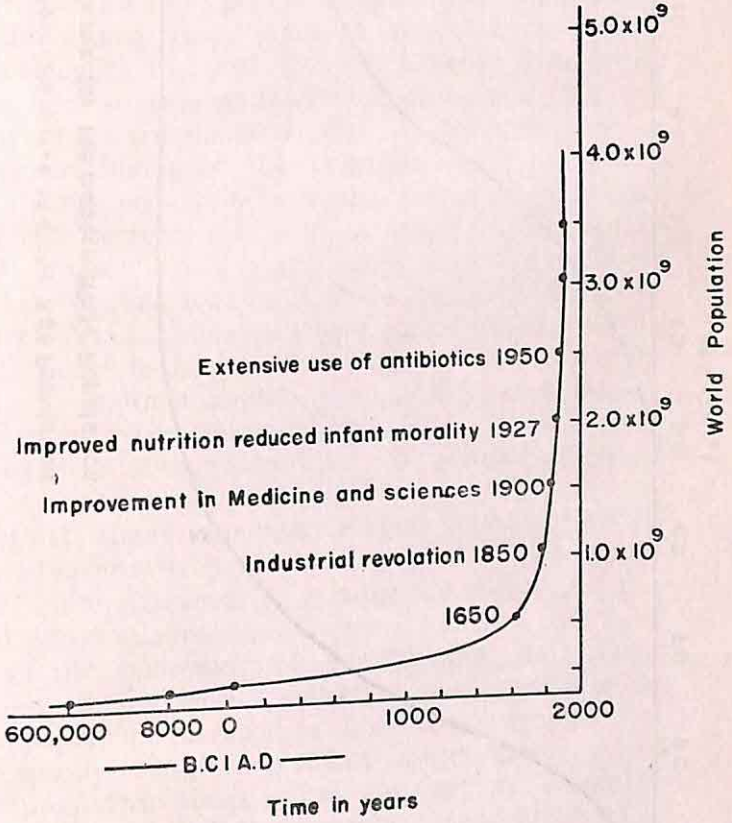

Fig. 3. A classic World Population graph. It shows almost vertical growth since 1950.

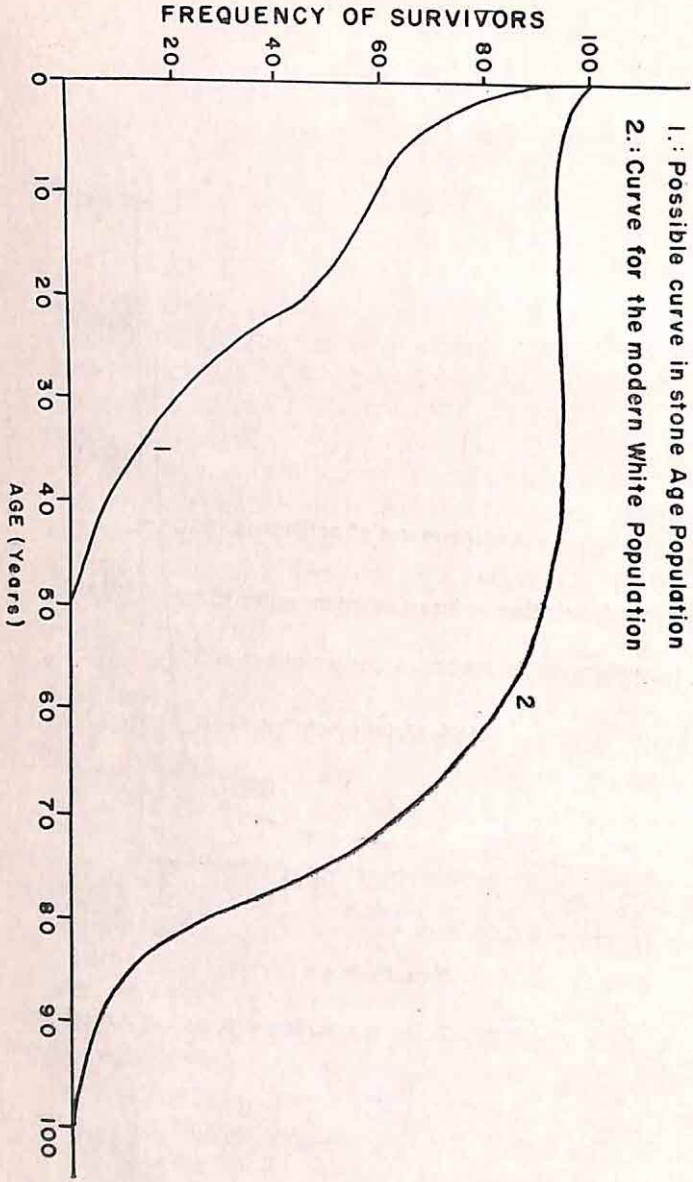

Fig. 4. Survival Frequency of Stone Age Population compared with the Whites. It is interesting to note that nearly 50 percent Stone Age individuals die before they can reproduce.

population pressure forces them to do so. So, the Boserup model sees population as 'a prime mover in society'. Conversely speaking, while population growth is considered capable of leading to an explosion, Boserup considers it as a prerequisite for cultural development.

Boserup's thesis has promoted major interest in population studies among prehistorians. In the past demographers and archaeologists had little contact between themselves. There has been a renewed interest in anthropologists and archaeologists in population studies in order to have a clearer understanding of the cultural ecology of early man. As a result population is highlighted as an important variable in the complex prehistory of man. Boserup's thesis in an age of such pressing population problem as faced by the whole of Asia today has dangerous implication for our survival. A colloquium was held in MIT Massasuchets in 1970 in order to go into the details of this thesis on the basis of empirical studies conducted by anthropologists. One of the major feelings emerging out of this threadbare discussion was that Boserup's was an over-simplified model of agricultural evolution which did not take cultural and ecological factors into consideration (Spooner, 1972).

Population growth is obviously crucial to the understanding of cultural process. It is primarily so because the cause and effect relationship between population and food potential of the environment is fundamental. Here again it is the population density which is more crucial than the gross population number in order to determine the carrying capacity of a given econiche. Unfortunately, population for prehistoric times is hard to compute. Attempts have been made in which the space occupied by a family, food consumed, pottery breakage or similar other indirect indications of populations have been used to compute population size. The available computed values of the prehistoric population size when compared with the world census figure demonstrate one of the most staggering growth curves (Fig. 3). The human population in our planet was estimated at a very meager figure of 0.125 million during the lower Palaeolithic period (about 1000.000 years ago). This figure increased to one million by middle Palaeo-

lithic period (about 200,000 years ago). About 6000 years ago when human culture had just developed urban characteristic in rudimentary forms, the size of population reached 86.5 million. In A.D. 1650 the world population stood at 545 million, and after industrial revolution and discovery of important medicines, i.e. at the beginning of this century, our total number of population exceeded 4,610 million. It is believed that by the end of this century we will cross 6,270 million (which will work out to about 46 individuals per square kilometer).

In terms of cultural ecology this steep growth surely indicates tremendous success of our species in adapting to the stresses created primarily by himself. In this process of adaptation he has been utilizing both replaceable and non-replaceable components of his environment. Newer technologies are being progressively introduced with two ends in view : to overcome stresses caused by population increase on the one hand and to fight the ill effects of earlier outmoded technologies on the other. The prospect of exhausting the non-replaceable resources seem imminent. There is a growing threat of extinction of the industrial base of our economy and hence culture. Since reversal to simpler economy is almost impossible because of near complete alteration of our environment, we stand today on the brink of an inevitable on-coming disaster.

The most likely question that might follow the projection of this gloomy picture would be 'what went wrong and where'. In order order to evaluate this question one has to again delve deep into the history of man-environment relationship.

If we construct a curve of wild animals surviving at different ages, we find that there is an unnatural high birth rate among them. Most of the young animals die before reaching the age of one year. Only those who are genetically best equipped and also those who are the fittest within a given ecological strain survive beyond one year. The number of survivors beyond three years likewise, become as less as 75 per cent of the total live births. The curve, therefore, shows (Fig. 4) a constant slope as the percentage of survivors beyond four years, five years and the

like are computed. It can be safely assumed that the population picture of prehistoric man must have been similar if not the same. The average longevity of Neanderthal (100,000 years ago) man was 29.4 years and it went up to 32 years during the early Christian era. Apparently this elimination rate at both the birth and death ends of the curve is in harmony with environmental demands. With the industrial revolution followed by the invention of modern medicines, the curve tends to bulge out into a convex line in the first half and gets farther in the second half. Life is no longer allowed to be lost easily either at birth or at senility. This caused a galloping rise in the population of our species. Apart from causing a tremendous pressure on our culture and resource base, the population itself became weak because of the choice of culture made by man during the early Neolithic period (about 8000-7000 years ago) i.e. the choice to settle down at a fixed eco-zone. He chose small areas near the river, cleared the forest around him with the Stone Axe newly invented. This led to so much of success in living that he started expanding along the rivers. Since basically all biological organisms are created to move around within an ecological zone in congruence with nature's cycle of flowering of various flora and littering of fauna, the choice of settled economy was heavily loaded with problems for the future of mankind. The initial success, however, was too tempting for man to realize the impregnated load. In fact, he became so proud of his polished axe that it soon became a symbol of power. The Battle Axe people of Central Asia passed the symbol to the Bell Beaker people of the Danubian region who copied it in copper. Even the Nordic god Thor carried the symbol of an axe. In the historic period the symbol of the axe was retained by the honourable corps of Gentlemen-at-Arms (A.D. 1526) in England. The Swiss guards at Vatican carry it even today in the form of the halberd.

Settled economy brought ranking in the society, and hence a large proportion of the population became unused to the rigours of raw living. There were small groups of people who did not choose to settle down. They remained

nomadic in the adjoining forests and hills and often raided the settled population groups. The consequence of this was the need of fortification and raising of a fighting class. Thus, an additional premium was set on child birth. 'You must produce many children or who will guard our borders' became the slogan of those who settled down. The nomads, on the other hand, took to shifting cultivation but were endowed with better knowledge of the environment. They domesticated the horse and made the wheel and soon became much more powerful than those living in cities and towns. History is replete with instances of these nomads conquering large and prosperous cities. The names of Genghis Khan and Tamerlaine as the leaders of the conquering nomads are writ large in the pages of history. The rise of population for the period from the Mesolithic to the 15th century was caused by two processes acting simultaneously :

1. The luxury of abundance in agricuture coupled with the constant need of soldiers kept the produce for settled communities at optimum speed.
2. When man predates man fertile females were never killed. They were captured for concubinage. The female captives contribute largely to the increase of population among the victors.

Finally, methods of voluntary population control by resorting to female infanticide was more in tune with the nomadic adaptation process. The need of population control among the settled groups was not felt for a long time. The increasing salinity of the soil caused by over irrigation, pests and weather shifts were some of the environmental backlashes which made the settled communities realize the hollowness of their total reliance on nature. The social structure broke down. New norms and newer technologies were introduced to remedy the subsistence failure.

A cyclic order in man's subsistence failure and the attempt to remedy it was observed by T.W. Fiennes (1978). On a careful analysis he demonstrated that the duration of prosperity was possible for 400-200 years. After that it could not be sustained. The cyclic order is as follows :

2000 B.C. A period of great prosperity and the rise of Minoan, Egyptian and Aegean Civilization.

1400 B.C.	Overthrow of the Minoan and Aegean Civilization. Indus valley reaches its nadir. Egypt is invaded.
900 B.C.	Rise of Babylonian, Assyrian and Persian Civilization.
400 B.C.	Overthrow of Assyria and Babylon. Alexander overthrows Persian empire. The world in chaos leading to the rise of Greek and Carthaginian empires.
200 B.C.	Rise of Rome and overthrow of the Greek and Carthaginian empires.
0-400 A.D.	**Pax Romana**—great prosperity
600-900 A.D.	Overthrow of Rome
900-1300 A.D.	The new world opens, but in general a period of civil wars, unrest, black death. Recurrence of Plauge in 1665.
1700-1900 A.D	Industrial revolution. Rise of Science and medicine. Increase in prosperity.
1900-	Savage wars. Population increase threatens to outstrip food resources. Decline in reserved fossil fuel. Beginning of a decline.

The above chronological arrangement of human culture prepared by T-W-Fiennes is an attempt to show the periodicity in human prosperity. Most Environmentalists may not be agreeable to accept it but the attempt clearly brings human cultural progression from Neolithic period onwards in a very concentrated manner.

Ecology and population

In the preceding section we have discussed certain fundamental problems in archaeology arising out of Boserup's study. Here we shall examine population as a variable of cultural ecology. It is needless to emphasize that such studies cannot be entirely based on archaeological data because of obvious reasons and hence ethnographically obtained information have often been used to substantiate the arguments which contribute to the process. Human geographers have been studying population variation

and ecological adaptibility from as early as 1891 (Ratzel, 1896) but their studies were not used for the analysis of culture analysis until the first half of this century. Population as a part of social environment has been examined by some anthropologists during recent years (Angel, 1972 ; Kroeber, 1939 ; Birdsell, 1957, 1958 ; and Polgar, 1968, 1972). Fekri A. Hassan's work is accepted as one of the most rewarding studies on population factors as part of cultural ecology (1973, 1976, 1978, 1979, 1981).

These studies successfully demonstrate how ecology and culture determine population size, its growth, or for that matter its density. Most of the hunting-gathering population, for instance is known to have a low density ranging from 0.01 to 2.0 person per square mile. The reason for this has been traced to the function of resource potential, food extractive potential and consumption level. The first two factors are directly proportional while the last one is inversely proportional to population density. The resource potential of a region, in turn, depends on the maximum sustained yield that can be removed without impairing the resource ability to replace the biomass harvested ; spatial distribution pattern of the resource, and the seasonal and the long term fluctuations in the resource abundance. Since the kind of edible resource is not same in two different ecological zones and since this needs different extractive strategies, two population activities are not comparable. The difference in quantum and nature of activities is known to have not only relation to the population size but also to determine its density. The converse of the situation may, however, not be always true. The overall similarities between two regions in optimum yield to man do not guarantee that the food resources available from both regions are similar in kind or nutritional value, i.e. man s recognition of what constitutes profitable 'food' is not cross-culturally uniform. The Mesolithic settlements in the nearest show enough evidence of this differential in food adoption. The availability of animal proteins or combination of plant proteins to supply adequate amounts of the essential amino-acids is as important a factor as the energy requirements in a pre-

historic population. Distribution pattern of resources, culturally chosen for exploitation from a given ecological complex, decides management of individuals within the group. It is only under fortunate circumstances that one encounters dense and concentrated food resources. The mammoth hunters of Upper Palaeolithic period of Siberia (20,000 years ago) or the Lower Palaeolithic hunters of the Sierra ranges (400,000 years ago) in Spain may be examples of some of these isolated areas of abundance. Normally it is the river banks which provide a greater and more concentrated supply of protein rich foods. Hunting-gathering population in prehistoric period was found more concentrated in such favourable zones. But for the river Vezere (Les Eyzies), South-west France would not have been such a paradise for Palaeolithic populations (Bhattacharya, 1977). Judged from this view point one of the most important consequences of agriculture has been the concentration of food resources at places of one's own choice. Seasonal and long time variation in the availability of food, or more specifically such food items which are of key nutritional value play an important role in regulating population density. Maximum population density is regulated by the amount of key resources available in their period of scarcity. In fact in contemporary hunting-gathering population we find that exploitation is limited to only about 30-40 per cent of the carrying capacity, i.e. the maximum population size that can be supported from an ecological standpoint in most optimal conditions.

Food extractive potential concerns the range of activities which include hunting, fishing, fowling, shell-fish gathering, foraging, big game hunting, smallgame-hunting, insect collecting and the like. The relative dependency of anyone of these activities can vary according to the ecological nature and hence cultural shade of the population. For instance, in tundra, where plant food resources are scarce, emphasis is laid on hunting. Tropical forests, on the other hand, provide a reverse ecological situation where herbivorous animals are scarce. Since carnivores are seldom preferred by man, a great deal of importance

is attached to gathering plant resources in these areas. The preference dictated by culture is another important factor which decides the type of resource to be concentrated on. Ethnography suggests many instances where a particular food resource in abundance may have been neglected in preference to another. For example, Lee reports (Lee, 1968) that among the Bushmen only 54 species out of a total of 223 local species known to them are considered edible. Similarly, although 85 species of edible plants are known to them, only 23 species constitute 90 per cent (by weight) of their vegetable diet.

The level of consumption which is the third attribute determining population density can be defined as the basic biological and social requirement. The lowest level is usually referred to as subsistence level. Bushmen in their desert ecology have been found to maintain an intake of 2,140 kilo calorie per day per individual which is little lower than the subsistence limit set by FAO (2,354) kilo calorie). The Bushman diet which constitute 33 per cent of mongongo nuts, 33 per cent meat and 33 per cent of other vegetable food, shows that food extractive strategy and ecology work together to achieve the consumption level. The role of social organization is important in regulating the populaton density over and above resource potential, and food extractive potential and consumption level. A large number of individuals within a hunting band can raise the extractive potential. But a band can work effectively only when individuals comprising it are better organized, and there is proper redistribution of resources. The limit of the highest and the lowest number of individuals constituting a band is controlled by culture. Ethnographers are generally in agreement that a local group or a band in a contemporary hunting-gathering population may contain 15 to 50 persons depending on the type of environment. With the increase of population local groups or bands undergo fission and independent groups are formed. A regional group or band aggregate is the total number of such independent groups which are related by ties of descent. The control of a large group is one of the most fascinating things to be observed within contem-

porary hunter-gatherer communities. A group of as many as 500 individuals, spread over an area of as much as 2000 sq. kilometers, has been found to successfully maintain group identity. Exchange of marriage partners or yearly ceremonial get-togethers during the period of seasonal abundance or exchange of food from one zone to another undergoing a period of scarcity are some of the noted methods used to achieve the group identity.

The study of growth rate of human population under the condition of hunting-gathering economy has been done by some anthropologists. Hassan (1973), for instance, estimates a value of 0.4 to 1.3 per cent growth after considering a spacing of 3.5 years for all the hunting communities in general. Application of the same computational norms to an Upper Palaeolithic site from the eastern Mediterranean region results (Hassan, 1975) in a maximum potential growth rate of 0.7 to 1.7 per cent. These figures are obtained after a liberal allowance of 40-50 per cent is made for child mortality, 10 per cent for maternal mortality, 12 per cent for sterility and 12 per cent for foetal mortality. This slow rate of growth is thought to be accountable by a control which is not only physiological. Cultural means of controlling population growth by induced abortions or infanticides is known amongst many a hunting-gathering population, and to assume that such controlling mechanisms were also in use during early Stone Age may not be taken to be mere flight of imagination.

A popular view held earlier was that our ancestors in stone ages were fighting a continual battle to keep the birth rate ahead of the death rate.. Even if mortality rate during this period can be accepted as 50 per cent before a child reaches the reproductive age, still the population can double in a generations time. Birdsell's (1957) intensive research among the aboriginal population of Australia seems to indicate that their population remained constant at 300,000 for 30,000 years. Deaths caused due to diseases were probably much lower in a hunting-gathering group. Infectious diseases and epidemics cannot be discounted before settled villages appeared. Even if the existence of such viruses are proved

death caused by them can never reach an alarmingly depopulating stage in a dispersed population. Hunters may have developed high levels of natural immunity as relatively high infant mortality helps a genetic selection of the biological weaker births. Consequently the only explanation of the lack of normal population growth in the hunting communities has been sought through culture and ecology. Culture evolves as a strategy of adaptation within a given ecological zone and subsequently the resource base is also culturally defined. Once this is done population density needs to be carefully controlled for the fear of facing scarcity. Prehistoric pre-occupation with fertility is a similar outcome in answer to the same fear. How was the population culturally controlled will possibly never be known to us. But examination of hunting-gathering tribes of today may throw some important clues to it. As for the stone age society it was provisionally held that infanticide, abortion or culturally introduced abstention were the only method used to maintain a desired population density. This could also account for the rapid growth of population estimated in areas where a prehistoric population enters for the first time. As if they allow their number to grow to a desired limit and then consciously limit further growth. One of the studies conducted in the last decade (Willams, 1977) on the ! Kungs of Kalabari desert seem to indicate that population control may not be always entirely a culturally monintored process. Apparently there is no regular inducements to eliminate children in this population. Infanticide is recorded only in case of abnormal births, or one of a twin pair or in rare cases of elderly mothers who cannot cope with more children. The ! Kung women complain that God is stingy with children and that they will like more children (in an average only five births per woman has been recorded). Prolonged breast feeding can at the most prevent ovaluation for a year and a half. This is much less than the spacing of ! Kung children. Independent physiological studies had earlier demonstrated that ovaluation in a woman depends on acquiring a specific fat level in the body. It was found that the ! Kung women are extremely dry and thin for

most of the time. Consequently it could be hypothised that during the period of breast feeding and subsequent 3-4 years of carrying around the child drains off the fat level of the women who do not anyway have a sizeable reserve of it in their body. It is only when the body is on its own and requires no specific looking after that the women begin to get a fat accumulation. Ovaluation begins only at this stage. Thus, a classic example of physiological adaptation to cultural demands can be demonstrtad in the spacing of the ! Kung children. It it not difficult to assume that during the stone age hunting society such a phenomenon might have been in force.

It can be seen from what has been stated above that the relation between food available for consumption and the nature of size is a complex one. That this relationship is basically reciprocal needs no argument. But 'the population growth, population size and population density will appear to be mutually interdependent, yet each of these elements is influenced by a different set of variables' (Hassan, 1975 p. 47). Thus, while the low population density of the hunter-gatherer could be a reflection of their low food extractive efficiency under a given environment, a high population density would not necessarily imply a change in extractive efficiency. This might as well be caused by a lesser social distance between the local bands and hence more communication and effective cooperation will result. The post-Neolithic growth of population may, therefore, be viewed as more a success of cultural mechanism devised to co-ordinate a larger population density rather than being merely caused by change in economy. This is not meant to deny the effect of positive role played by security of food supply and sedentariness on the growth of population. Hassan's model, as elucidated above, demonstrates that, in spite of the knowledge of agriculture, a community may not be successful in increasing population if additional cultural prerequisites are not developed. We have numerous examples of agricultural communities being surrounded by hunting-gathering hordes from contemporary tribal data, and the explanation of such a phenomenon can best be demonstrated by this model.

One of the best effects of the introduction of agriculture was a marked rise in carbohydrate intake with relative lowering of animal protein in the diet. Studies in palaeopathologies (Cockburn, 1971) indicate increase in the incidence of infectious diseases like malaria, dysentery, and intestinal parasites due to dietary change. The newly acquired human sedentariness conjoined with growing population density contributed to this increase to such an extent that the situation might have become alarming. But in spite of all these, the growth of Neolithic population remained unchecked which can be taken to mean that the population controlling means must have been relaxed. The process must have been a conscious one maintained through the means of culture as the society learnt to equate more people with more harvest and hence with more success.

4

Ecology and Early Agriculture

Origin of agriculture and encient civilization has always been a fascinating project for archaeologists in many parts of the world. As early as 1951 V. Gordon Childe pointed out to the successive rise of various cultures in temperate Mediterranean, Nile valley and Mesopotamia and also to the slow development of farming in each of the zones on the basis of archaeological evidences. Etiology of the process of this change, however, remained unexplained within available methodologies in archaeological researches till then.

Discovery of early agriculture in areas spread over Middle East, Southeast Asia and Mexico made the need of a second look for its orgin very improtant. The work of Boserup caused a great flurry among arcraeologists and an intense search for more empirical data on Neolithic agricultural sites started. The inadequecies of their knowledge of plant genetics was soon realized by archaeologists. Areas of distribution of some wild cereals were being attempted by botanists and archaeologists, and they inspite of themselves started heavily leaning on these data to explain the birth of agriculture. Cultivation of wild cereals through human agency need not always be on a botanically homogenous environment. That is, the expected chromosomal changes in the domesticated varieties could not also be expected to take place. In the same manner the identification of domesticated animals from archaeological remains posed severe problems. Before palaeontologists could work out confirmed morphological changes in an animal with its domestication, archaeologists started using the possibilities hinted by palaeontologists as established rules.

Consequently a large amount of archaeological studies claiming early agriculture and animal domestication started being reported. Many of these could not be accepted by specialists. Another important feature of all these studies had been the general disregard of human cultural and micro-environmental constraints which work hand in hand to determine the choice of economy adopted by a community. Some authorities went to the extent of hypothesizing at least a dozen centres where early agriculture might be independently evolved but could not provide either adequate data or reasons to spot such areas so that investigations in an intensive manner may be initiated. The situation regarding the domestication of animals seems to be comparatively in a bigger confusion than the cultivation of crops. Almost all the morphological attributes earlier believed to be the result of breeding in isolation from the bigger 'gene pool' of the wild community seem to have been found to be wrong on the ground of empirical experimentation. Naturally most of the archaeologists are left with no other alternative but to fall back upon the older common sense approaches used in the early fifties. The situation is further complicated by the ethnographic accounts which show the practice of domesticated females of a species being deliberately exposed for mating with the wild males in some communities.

In view of the above we have to accept that we have absolutely no scientifically proven method of identification of early plant and animal domestication from archaeological data. Nonetheless, some of the attempts in archaeology which consider the conditions of early economic changes merit discussion. It is important at this stage to mention that such attempts by no means should be taken to establish the fact that areas hitherto not properly studied may not in future yield additional informations towards our understanding of this economic change in man.

Origin of agriculture in the Middle West, or more precisely domestication of wheat and barley in this region has been largely held on the basis of archaeological remains of Neolithic sites of early dates being known from an area which covers modern Turkey, Iran, Iraque, Israel

and Syria. Harlan and Zohary (1966) recorded the geographical distribution of these creals from parts of this area and indicated their genetic similarities with the domesticated varieties. The generally accepted view was that plant domestication must have begun in such areas where wild ancestors of the domesticated species are abundant. This was merely a logical assumption based mainly on plant genetics. This was not precisely investigated from archaeological records and neither could such early stages be genetically discriminated. Harlan and Zohary described many thousands of hectares in Iran in which wild wheat and barley grows. If such an abundant wild supply could be harvested by early human groups without harming their reproducing capacity the need of withdrawing these plants for separate cultivation would seem to be illogical on cultural grounds. Hence the time of plant domestication in such areas may be substantially delayed. It was argued that though these wild cereals were collected in the areas of their wild growth their actual domestication must have been caused by a different set of reasons in a different place where these are not found in wild. Evidences from Tell Mureybad (Flannery, 1969) a site on Euphrates in Syria in this regard was found to be extremely enlightening. Here a preceramic cultural level with clay walled houses, grinding stones and roasting pits and with a radiocarbon date of circa 8000 B.C. yielded large number of charred grains. None of these grains could be ascertained as domesticated. Consequently such archaeological indicators as grinding stones and in some places the existence of crude ceramic technology would now have to be only provisionally accepted as evidence of a pure Neolithic culture. The work of Flannery in Iran (1969) and that of Mac Neish in Mexico (1971) are two important archaeological studies which needs consideration for our understanding of origin of agriculture. Subsequently Harris (1973) attempted to review these works in order to explain the origin of agriculture in the tropical regions along the same line of arguments.

As regards the finds of Flannery from Near East, it will appear that the Mesopotamian plain and the Zagros

mountains produced a number of contrasting environments within a limited geographic area. The valleys at different elevations experience so much difference in rain fall, temperature and vegetational features that these micro-environments could be conceived of as a vertical climatic gradient. The higher altitude had a shorter hot spell and received cold air from neighbouring snow clad mountains in winters. The middle heights received more rainfall and could maintain larger vegetation. The lower levels were the most influenced by the neighbouring desert climate but could maintain occasional clusters of sturdy bushes along the fertile alluvial spreads. Existence of this diversity of ecology, it was argued, played an important role in the origin of agriculture in this region. Evidences of the earliest prehistoric occupation in the area seem to last until 10,000-8,000 B.C. Culturally, this period shows an adaptation to a semi-nomadic hunting-gathering economy. The second period of occupation, which lasted till about 5,500 B.C. marks the beginning of early dry framing along with goat and sheep domestication. The domesticated plants include emmer wheat *(Triticum dicoccum)* and two row hulled barley *(Hordeum distichum)*. Permanent villages with mud plastered houses also appear in this period. It is in the third phase, which lasted till about 3000 B.C. that Flannery finds a larger variety of domesticated wheat, barley, lentils, grass peas and linseed besides the evidence of domesticated cattle, pigs and dogs. In many low land areas the evidence of even irrigation channels also appear during this phase.

The question that arises in the present context of enquiries is : What caused this change in subsistence mode from phase one occupation to phase two. The possible causes for such a change could be ecological, cultural or demographic. Keeping in line with the purpose of the book I wish to argue that none of these causative forces are isolated from one another. Infact one combines with another to modify a third or fourth factor. It is my contention to demonstrate that if the culture of a given community is tuned or adapted within a given ecology a change in the culture does not occur until a third or a bigger force dis-

balances the equilibrium. Bushmen of Kalahari desert do not experience any acute ecological pressure to change their culture in spite of the othtrwise inhospitable ecology of the desert. It has been demonstrated that one individual need to work for only 3 days in average in order to be able to consume 2100 kilo calories per day for full 7 days of a week (Lee, 1968). This is perhaps a classic example of "The Zen path to affluence" as Sahlins puts it. (Sahlins, 1968).

In Iran the ecological situation could not have been all that altered from phase one to phase two, in order to result in a change in the economy. If it had undergone such a change the pollen spectrum would have indicated it. That is, at least in this particular evidence the traditional explanation of a change in the physical environment alone does not explain this phenomenon. Flannery tries to explain this on the basis of cultural ecology. It is argued that the gatherers because of the security of supply and the relative sedentary habit at the nucleus zone (where wild crops grow) slowly increased in number. This may have resulted in higher population density and subsequently disbalanced the carrying capacity limit. Since human populations maintain their density always below the optimum food potential of the environment by culturally governed means, this stage by necessity required periodic migration of 'daughter' bands from the nucleus zones to marginal areas. In the marginal areas the new arrivals tried to recreate the same crops which he had earlier harvested in the wild. Efforts at these early cultivations were soon reinforced by favourable mutations in the cereals themselves. This hypothesis could also explain the absence of domesticated seeds in phase one of Tell Mureybad.

It is interesting to note that gathering of wild cereals when available and also hunting do not decrease even after the emergence of early farming. That dry farming does not provide a secured food supply because of the possibility of rain failure is quite evident from these transitional overlapping economies. Furthermore the total restructuring of the society required in order to adapt to this change in economy could not also have been complete.

Animal domestication is intensified for security of meat supply along with this change. Dry farming or dependence on rain water for farming would appear to be the main cause of the simultaneous continuation with earlier economy and thus delaying a total transformation of the society. Likewise the early farmers had to sometimes face years of unpredictable bumper crops. These are more useful when converted into craft items or live stock rather than merely stored away. In Mesopotamia this surplus seems to have been used for the acquisition of animals by trade or exchange. Sheep or goat acquired with agricultural surplus in good years can be exchanged with other areas for grains in the lean years. These evidences will suggest that, at least in Iran, plant cultivation and animal herding were not two separate subsistence activities but were interrelated as a "banking" mechanism. Long period of fallowing alone can provide grazing for a substantial livestock in these early agricultural groups. Consequently the native plant cover of the area was totally changed within a short time. The fallow land changed into pasture variety of plants were indirectly used by man and through his animals he could utilize the energy from the changed economy. Success in cultivation was so involved an issue for these early cultivators that introduction of irrigation was only a natural consequence. Culture takes a decisive step towards a complete change by the time agriculture with irrigation become established. Again archaeological evidences suggest that irrigation as a technological innovation seems to have developed in areas of less favourable climate. The well watered uplands of Kurdisthan and Luristhan, where early dry farming had already been a success do not show this innovation for a fairly long time. On the contrary, the low land steppe of Khuzistan, which is a treeless plain receiving about 30 cm. of annual rain today, takes to irrigation agriculture much earlier. Irrigation certainly stabilizes the harvest and also increases the yield but it has an adverse consequence as well. If irrigation is not accompanied by proper drainage it tends to bring salt to the surface by capillary action. The strategy employed in Khuzistan low land seems to have been concentrating on bar-

ley which has a higher salt tolerance than wheat. It is, therefore, no coincidence that barley farming and sheep domestication occur together at this stage in Iran. It will no be wrong to state that from the hunting-gathering economy man chooses a limited number of species of plants and animals for domestication. This selection made him lose an unlimited number of choices that he enjoyed in the prvious economy.

A point of argument that can arise at this juncture is whether population increase in the abundance area of wild food collection is purely a consequence of security in supply. We have no demonstrative mechanism to pin point the cause. However, that the ecology was mainly responsible for marked decrease in the extent of territory covered for food collection can be ascertained from the nature of the micro environmental variation of the Zagros. Although the situation may not be quite comparable to semi-sedentary nature but even the slightest decrease in wandering can accommodate a considerable shrinking in the spacing gap of pregnancies. Coupled with this better nutritional supply helps the hastening of the maturing process of the offsprings and thus lessening the period of dependency of the child on the mother. These two factors in combination may have indirectly helped in bringing down the spacing between two children and thus encourage a rise in the population (Wright, 1971).

A population increase preceding the onset of true agriculture seems to be broadly indicative from archaeological data. This, however, does not seem to be as simply related as Boserup seems to have conjuctured. Variability by micro-zones, relative abundance of wild grains in a limited territory or even proximity of desert, making wide migrations economically uncertain (both Mexico and Mesopotamia show desert climate surrounding the area of first cultivators) may have acted in combination with population increase to cause the onset of the process that leads to agriculture. This process must have passed through a long period of pre-adaptation to a psychological disposition, technological innovations and also cultural maturity to afford a fuller adaptation to settled life. Recently Bela

(1981) reported certain fascinating evidences of food collecting methods in Rumania, Hungary and the neighbouring regions. During autumn many tribal and peasant groups in these areas collect hazel nuts stored by mice and red squirrels by breaking their borrows and nests. Tree trunks in which wild mushrooms are growing are collected by the peasants and brought down to their own homestead to be harvested at will. Another interesting case is cited about exercising authority on plants. Jay birds (**Gurrulus glandarius**) drop grains of fruits in flight. When young trees grow from these stray droppings the Szekters provide them with property marks by tying some thread and grass around them. These collection practices would obviously indicate that food collection economy may not be a purely random technique and may have included rudimentary domestication of plant at an early stage. Many modern commentators believe that this process may have started well within late Palaeolithic period in suitable ecological zones. Man started concentrating more on fishing and shell collection in the temperate regions. Unlike large mammal hunting in open savanna the adaptation to maritime economy did not require large wandering range. Ecological change during the end of Pleistocene (10,000 years ago) was gradually removing the large mammals from their earlier habitat and in conjunction to this large areas were being converted into swamps and lakes by the melt water of the last glaciation. Human change to maritime economy, therefore, was merely a step towards adaptation within the changed environment. This may have triggered off a chain of cultural changes beginning with sedentarism (Binford, 1968). In other words, while agriculture was being developed in the peculiar micro-climate zone complex in some regions, in the rest of the hunting areas clltural requirements of sedentarism seem to have been initiated although because of some other varieties of environmental constraints. Once the stage is erected the adoption of the new technology is only a matter of time, by way of chance contact or diffusion.

In the Tehuacan valley (Mexico) Mac Neish (1971) records a slightly different situation. Here the archaeological

records suggest that possibly nomadic microbands evolved into what the author calls the **Seasonal Macro-Microbands.** He feels that the Pleistocene Mammals having withdrawn from their environment the population had to wander into large areas in small bands to collect wild food for most of the year. Hunting of alternately available herbivores still constituted 54 per cent of their supply. It was only in summer when the bounties of nature provide a large selection of floral products that the microbands rejoined to form the macroband. The process when continued soon led them to cultivate their favoured forest flora by progressively specialising their collection techniques. The avocado cultivation may have been one of the earliest domesticates although this required a special adaptatioin and technique of hydro-horticulture. The possibility of such micro-macroband fission and fusion for seasonal foraging may not be altogether difficult to imagine in the Mesopotamian region—at least during the transition to final settled villages with proper agriculture.

With the relatively recent discovery of Non Nok Tha and other evidences of early cultivation from Thailand (Bayared, 1970 ; Gorman, 1969, 1970) a new dimension to the problem of agricultural origin has now been added. It appears that small groups of wandering populations in the tropical forests of Burma and Thailand had already domesticted varieties of bananas, taro, sugarcane and coconut and possibly even rice in as early as fifth millenium B.C. Unlike the situation observed in Mexico or Mesopotamia tropical rain forests are areas with more than 200 cm. yearly rainfall and a humidity of over 95 per cent throughout the year. In northern Thailand these forests are made of large trees (mainly **Dipterocarpaceae**) going up to a height of 30-40 meters or more. Another characteristic of these forests is the feature of wide floral diversity. It may sometimes reach a level as high as to maintain as many as 200 tree species within a forest plot of 0.02 square kilometer, with no single species being dominant. The distribution of these species is also highly discontinuous. That is, isolated members of the same species may be found hundreds of meters apart. These will natu-

rally imply that ecological adaptibility of the species is much narrowed and a slight variation in the environment may make them lose their viability.

A hunting-gathering population seeking adaptation to such an environment has to, by necessity, maintain small groups to enable high mobility in order to cover the extremely dispersed range of any one plant suitable for collection. The exploitive pattern, therefore, tries to maintain a generalized technology and do not opt for any specialization. It is likely that within these wandering groups the need of sustained supply of plant stapples were felt by more than one group independently. The need of sustained supply need not have to be sought only from either a sudden ecological change or a population increase. It could have occurred by a combination of many other cultural factors besides these two. One thing is certain, that with the onset of Holocene a marked change in the climate has generally replaced a large percentage of the total biomass. A gradual adaptation to the changed scene is bound to culminate into a point of take off for security of supply. In the tropics more than 90 per cent of the tall treas are flowering kind and they provide a canopy for the proliferation of banana and other asexually reproducing varieties in the shade. Man had to only manipulate the environment to be able to domesticate some of these plants. Harris (1976) calls this change as **'lateral'** in contradistinction to 'vertical' transformation observed in earlier instances. Harris (1973) goes at length to describe this change in the tropics. "Thus, when cultivation is based on ecosystem manipulation.....it achieves the objectives of channeling energy to man through cultivated plants by substituting for wild species in equivalent spatial and functional niches a mixed assemblage of cultivated tress, shrubs, climbers, herbs and root crops, thus stimulating the structure and dynamics of the natural ecosystem without wholly replacing it" (page 394). In contrast to this, the ecosystem transformation implies longer period of selective breeding which in time changes a large part of the natural environment and bring about a more specialized involvement in crop production activities.

The tropical variety of change over does not exert much pressure on the process of cultural adaptation and hence survives parallely with more or less a hunting-gathering kind of society. The situation is comparable to what Mac Neish speculates for Mexico, although the set of reasons in the two cases are entirely different. Coupled with this, the nature of tropical forest calling for large home range does not allow the population to grow in that significant a way as it would in a closer and more homogeneous ecology. Since tropical environment is rich in asexually reproduced cultigens, it is quite likely that the emergence of cultivation in this area should more appropriately be termed as "Vege-culture". Annual seed crop cultivation appears with paddy in a relatively later date. Harris (1973) argues that unlike the general opinion held by many (Boserup, 1965, page 16-18) fixed plot cultivation must have preceded shifting cultivation with long term fallowing system in the tropics. The nitrogen rich refuse heaps near human settlement areas was most appropriate and technically less taxing for fixed plot cultivation. The need for extending this to shifting cultivation must have been motivated by a population increase whereby need of more yield became compelling. This had, obviously, called for more labour and implements to clear large patch of forest and then planting the already domesticated variety of seeds. A population adapted to shifting cultivation needs to be more mobile than the fixed plot cultivators and hence such a form of agriculture can soon spread over larger areas. It needs specially pointing out that the change over to "vegeculture" was not to man's overall benefit in some regards. The root and tubercrops supplied very low protein content and hence the population has to depend on alternative supply of protein for balanced diet. Unlike Mesopotamia (where live stock raising took place) in tropical region fishing seem to have been specialized. Both Binford (1968) and Flannery (1969) supported the fact that a combination of econcultural facors as described earlier can explain the origin of agriculture. In the tropics, however, such a model is not entirely successful to explain a separate ori-

gin of agriculture, although there is a comparability of the "Vegeculture" stage with the stage of wild seed collection in Mesopotamia and the micro-band foraging in Mexico. Hassan (1976) revised the above model and viewed the origin of agriculture as having been caused by a significant change in settlement, subsistence strategy and demography which were attuned to micro and macro-environmental conditions of the region. The use of wild cereals by prehistoric populations is known from as early as 14000 B.P. in Palestenia (Van Zeist 1969). In Hassan's own words "once wild cereals were incorporated, a positive feed back network was established due to the great economic potentials of cereals, which eventually led to subsistence complex, a pattern of settlement and residence and an intra and inter-group organizational structure linked with intensive utilization of wild cereals" (Page 604). The consequence of the formation of this relatively sedentary group was an increase in the population, which in turn resulted into the birth of a number of daughter bands. The daughter bands move out in the neighbouring areas and continue their parallel economy of hunting-gathering along with collection of wild cereals. Since more often than not wild cereals are not available in such concentration in the new zone, they continue with their wide spectrum hunting-gathering economy. This is not considered an economic regression because the new band can always establish an exchange relationship with areas where wild cereal collection forms the main activity. The hunting bands can exchange animal meat with cereal collectors. This calls for an extensive inter-and intra-group co-operation. Wild cereals grow over large elevated flats in Palestine. Potable water on the contrary, usually flows in the lower plain. A small group can divide its time between collection and transporting water to the home base. With the increase of population of this area such trudging for water becomes more and more contradictory to sedentary psychology. Relocating the wild cereals near the riverine plain should, therefore, be the most logical alternative. It would be seen that Hassan's model puts more emphasis on the organizational factor as having triggered the origin of agriculture.

Recently Hayden (1981) has categorically challenged both the views of the cause of agriculture that are being discussed above. Climatic change and/or population increase in isolation, according to him, does not convincingly demonstrate this shift of culture. He has examined a model whcih he proposes to call the 'resource stress" approach. It is true that earlier models do not pay adequate attention to resource diversificaion as a causative force to elucidate technological and hence cultural proggression. Yet to attempt a theory based entirely on man's progressive shifting towards small, short maturation species as being the prime contributor in the birth of agriculture would also seem to be untenable specially in view of the situation in the tropics discussed above. A complex multiple causative scheme alone can come nearer to the truth. In this regard Hayden's attempt can be accepted as another important aspect that needs to be considered in seeking an answer to the problems raised.

5

Ecology and Social Formation

The attempt at tracing the origin of social formation from archaeological sources has never been made because of obvious inadequacies of our information. Evidences from Terra Amata in France and Torralba-Ambrona in Spain (Lower Palaeolithic) have providel significant information regarding the earliest type of corporate living in the form of group living and co-operative hunting but no other social traits beyond this are discernible. The Terra Amata groups pitched their temporary tents at the mouth of fresh water course near the French riviera. The fact that several of these tents were erected with each one of them having its own hearth is a positive proof of a harmonious life being led by more than one 'family'. At Torralba-Ambrona (A Lower Palaeolithic site in Spain), likewise, the possibility of group hunting has been confirmed by all archaeologists. The site is littered with skeletons of butchered elephants on a narrow crevice at a high altitude. It is believed that several groups of Palaeolithic hunters used to converge on this site during the seasonal migration of elephants and chase them off the cliffs. It is also believed that they used to butcher the elephants and eat their flesh. But from the huge stock of elephant skeletons found in the site, it is surmized that it could not have been possible for a single group to consume all the elephants. The existence of corporate activities at an early stage in human history is thus established by the findings of the site. Anthropologists like A. R. Radcliffe-Brown, Joseph Birdsell, Julian Steward and others have established a generalized picture of a primitive 'horde'. A local group of 10 to 25 people consisted of males, females and children. Usua-

lly the group was divided into smaller several economic units (similar to families), each of which would contain a male, a number of females and their offspring. These production units were loosely tied up with two or three similar units to form the horde. These are highly mobile within a given territory defined for the horde by a common myth. The mobility of the horde was highly organized so that the seasonal bounties could be made available to it and dry zones in summer could be avoided.

In most cases the units were male dominated societies, although the importance of females as child bearers and gatherers was fully recognized. The exchange of females from a group to a neighbouring group was evolved as a convenient mechanism for establishing alliances over the area larger than what one horde could maintain. Such alliances were useful for providing security of supply during periods of stress in the area traversed by a horde. Political power, which covered both organizational discipline as well as privileges in resources, was maintained by a few who had intimate knowledge of the area. Besides these few indications, tangible institutions within a mobile structure are not usually demonstrable in archaeological remains. Palaeolithic stage in human history, as such can at best be described as a prelude to social formation. The process of social formation is crystalized by the addition of agriculture.

Here it may be of interest to ask whether agriculture was adopted by those communities only which showed possibilities of forming complex social institutions. After all, hours of work put in by a hunting community per person does not vary substantially from the same in a cultivating community (Lee, 1968, Rappaport, 1971). Increase in the per head calorie produced and hence the ability to support a larger population with the same labour input is the main breakthrough achieved by a cultivator. Controlling a larger population requires an organized social order. The most significant question therefore is whether the adoption of productive economy will have the same appeal for every hunting and gathering group. Evidence of domestication of wheat from as early a period as Upper Palaeo-

lithic in Israel (Noy, et al., 1973) is now being claimed. But a true productive economy takes at least 4000 years or more to develop. The delay in the adoption of agriculture, therefore, is not due to the lack of the knowledge of seed reproduction. On the contrary it can be ascribed to what Marx would term as the delay in the change of ideals. Archaeological informations are inadequate for ascertaining the cause underlying the emergence of agriculture and the delay in its adoption. The study of contemporary peasants may yield cross-cultural informations which may be helpful for tracing the probable factors associated with the development of agriculture.

Studies in agriculture basically refer to man-to-soil relationship which directly influences man-to-man relationship. Ethnographic studies in agriculture usually concentrate on either technology or economics of agriculture rather than lay emphasis on the whole structure of the society. Netting (1974) summarizes available information on agricultural communities with a view to forming a cultural ecology of agriculture. He calls his summary the **Agrarian Ecology.** His work amply demonstrates that the adoption of any given type of agriculture may not entirely be explained as a mere stage in evolution. It may as well be a conscious choice of a community depending on its social and ecological variables. The change over to agriculture is basically assumed to be a change from meeting mere domestic needs to an economy of surplus (Sahlins, 1974). A production unit (household) decides its own needs on individual level. Political authority raises over this system for mobilizing productivity above this culturally determined cut off point. The desired quantity of surplus which may possibly be produced under a given situation is determined by a variety of factors and hence cannot be generalized. Further, the available quantity of fertile land, the surviving potential of the botanical species, the precipitation in the environment, the kinship and family organization of the adopters are few of the many significant variables that decide the requirement of surplus and hence the type of agriculture to be adopted. On the basis of Boserup's therory the correctness of which may be con-

ceded for the time being, even population density of the community may play an important role in deciding the adoption of a particular type of agriculture. A few ethno graphic -examples may domonstrate diversities in adoption strategies. Wet rice cultivation in Madagascar, according to Linton (1939), may have led to fortified villages, class stratification and a feudal kingship based on allotment of land and control of irrigation. On the other hand, highly intensive permanent cropping has been found to flourish in Nigeria in the absence of a state (Netting, 1968). The **Turus** of East Africa cultivate millets with obligatory labour from lineage members (Schneider, 1966). The **Chimbu** of New Guinea require diverse and scattered land types and as a result land is individually sought which eventually weakens the political unit of the clan (Kelly, 1968).

Normally intensification of agriculture is not a pressing need in a community as long as (i) hunting and gathering persist as a subsidiary economy and (ii) suitable free land is available to accommodate the normal demographic increase through generations. Under such conditions there is neither any pressure for newer technology nor is there a high degree of stratification evolved within the society. A community of such early peasants tends to create more nucleated habitation clusters, and develops complex social codes of behaviour. The produce of the land still remains more or less for the domestic production unit. Hunting and gathering products might be shared by all the members. Leadership mainly follows the age stratification pattern of the tribals. It is due to the **intensification** of agriculture that the actual 'revolution' takes place. When intensification is sought through improved technology, spatial mobility again becomes insignificant. For instance, when stone axes of Neolithic farmers were replaced by copper axes (3000 B.C.) and subsequently iron axes (1000 B.C.) more and more difficult areas could be brought under cultivation. No community can afford large-scale labour intensive production process unless it has :

(ii) a basic need for intensification ;
(ii) a large labour pool ;
(iii) the ability to govern and use the labour to such

an extent as to be able to meet demands which are several times more than the individual demands and finally.

(iv) an adequate distribution system to utilize the products of intensification.

The real point is that the basic need for intensification may arise only within a given social and ecological set-up. A given community may go in for intensification only when it can afford to fulfil the condition of the three requirements within a structured framework. The physical and social environment creates the **first** requirement while the other three requirements are generated. In case a community is under stress and needs intensification of resources though not having the required infrastructure, it may choose alternate strategies of adaptation. Pastoralism, as such is a form of adaptation suiting a community like this. If intensification of cultivation is achieved by spatial mobility, the result is the rise of a different kind of social organisation in contrast to those communities for whom suitable land for expansion is not available. For instance, the emphasis on the line of descent for the control of the produce would logically seem to emerge more possibly in the latter kind of situation. The need to keep agricultural land intact within a production unit through male line of inheritance may result in a growing trend of individual control and waning of corporate activities. The birth of overt political control becomes necessary at this stage. Polygamy or activating warfare culture to acquire slaves are some of the important possibilities that may emerge to culturally solve the problem of intensification at community level. In other worls, we may consider (a) dense population and (b) intensification of agriculture at two most important causal forces if we are seeking the roots of social formation. Conversely speaking, communities with sparse population and hence less of individual competition for resources are less likely to develop a strong centralized authoritarian culture. Social formation in archaeological sense has here been conceived of as synonymous with central authority. Whittfogel's 'Oriental despotism' (1956, 1957) elaborates this relationship for some selected

archaeological cases. Organized labour, generalized taxation, judicial mechanism and an administrative bureaucracy are some of the social-political attributes considered to be results of adopting wet cultivation. We hold the view that intensification of agriculture, no matter whether it is achieved through irrigation or through other possible ways, leads to a centralized socio-political system of one kind or the other. Both the cause (intensification) and the effect (stronger sociopolitical structure) are dependent on the ecology and the personality of culture of the community.

Ecology has a significant role in the feasibility of intensification and hence in the creation of a surplus. We have already probed population growth and its relationship with ecology. Increase of social complexity has an indirect relationship with ecology. Three primary variables identified above, viz., population growth, intensification of subsistence and increase of social complexity, are interrelated and have been chasing each other in a triangular relationship ever since man adopted settled economy. Ecology is the circle which encompasses the triangle with its three points lying on the circumference. Technological status of the community is the radius of the circle (Fig. 5). The three points remain at equal distance from each other, and hence any change in the distance of ab (representing the population) will require changes in ac (representing intensification) and bc (representing social complexity) to keep the triangle an equilateral one. In other words, any change in these factors eventually requires a change in the culturally defined ecological boundary which may be made possible only by changing technology to intensify control over a larger aspect of the environment. In case the community is incapable of doing so migration occurs, and hence another circle takes birth within a different ecology.

The fourth factor which holds the social complexity and regularizes it is the ideological realm. This has often been recognized as a barometer of change. Paradoxically, evidences of the ideological factor from archaeological records, in Neolithic and younger periods, are not much wanting. Lack of a centralized organization is impregna-

ted with the possibility of the existence of multiple spirits/ powers in the community's belief structure. Therefore, there are heterogeneities in the cult and ritual remains. In contrast to this, the emergence of state usually gives rise to a state religion from which the king derives his power. In other words, a secular state or secular civilization is anthropologically not possible, at least in the period of its emergence.

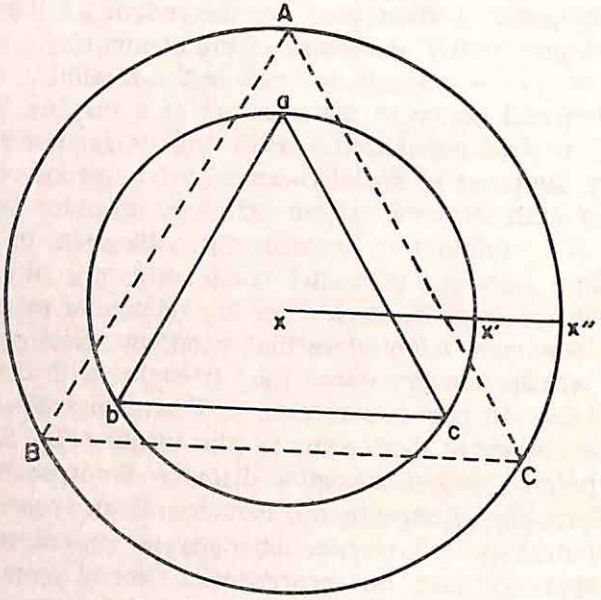

Fig. 5 Intensification of Agriculture and its relationship to Population density, Social complexity, Technology and Ecology.

ab—Population density
ac—Agricultural Intensification
bc—Social Complexity

When the culturally defined ecology is represented by the Circle abc defined by the technology XX'

AB—Population density
AC—Agricultural Intensification
BC—Social Complexity

When the culturally defined ecology is expanded with the help of a improved technology XX'' either because of or due to change in any one of the given three factors.

It may be kept in mind at this stage that the need of animal meat for balanced diet, animal hide for clothing, honey for adding sweetness to food and numerous other

forest products must have been constantly and acutely felt by every early agricultural community. A successful organization in procuring regular supply of the forest products required the establishment of non-hostile relationship of the agriculturists with hunting and gathering communities. Barter of agricultural produce for the forest goods appeared to be the ground on the basis of which such relationships could be established. In other words, any archaeological record of domesticated cereals in a community may not be enough to prove its peasant status. Grinding stones, limited occurrence of finished products of higher technology and many other ancilliary cultigens automatically intrude into these hunting and gathering cultures. The ideological realm, however, does not change so easily.

Not much has been said about value structure that results from the final and fullfledged agricultural development. Early historical records have been used by several historians to rebuild a meaningful picture of the society in its various aspects. Researches in Indian history done by D.D. Kosambi (1970), R.S. Sharma (1958, 1975, 1983a 1983b), Iran Hibib (1982), R.S. Burton Stein (1980), and Dev Raj Chanana (1960) are of immense importance for understanding the result of intensification in this subcontinent.

Value loading to the concepts of chastity and virginity might have evolved in human society along with the development of agriculture. Use of sex to grant favour or sexual exploitation of less privilaged ones within a structured framework is not wanting in ethnographic examples. It may not be wrong to assume that the practice was accepted by the early domesticators. Taking to agriculture was a difficult choice for the group which had led nomadic life. Its social structure had evolved through a specific adaptation successfully sought for nearly a million year and could not be discarded overnight. The period of hesitation may be assumed as the period when both hunting-gathering and cultivation were practised simultaneously. At the moment of taking decision the group was faced with the biggest problem, viz. population. Chastity, virginity or the premium on virgin marriage, virgin rituals/cults includ-

ing the ultimate in chastity of **Sati** system may all be viewed as mechanism of keeping the population within the means of the domestic production unit. They also served the purpose of keeping individuals from being too powerful to transgress upon the community surplus. The women being defined as pure and untouched 'machines' of production and hence of tremendous economic potentiality could still serve the purpose of exchange between two settled communities. The hunters and gatherers who could be trapped within the system by the lure of a secure supply became a labour pool for the peasants. These hunters-gatherers came close to the cultivators but continued to stay within their age-old social system. Consequently, if they have a system where chastity or virginity does not exist as a concept, the agriculturists develop a whole superstructure of rituals to define these values. If, however, the peasant wants to escape the system himself, number of females within his labour group will have no cultural objections to granting sexual favour to him. This enables him to keep his population regulated and increase the population of his cheap labour making them bend to stricter allowances. The labour community may even welcome the process because it helps him to 'import' his mentor's abilities and looks without any compromise with his social norms. To keep the chastity/virginity value the peasant has often resorted to morally compelling the labourers to part with their daughters for serving their temple deity which meant granting sexual favours to the priests or even to the other male members of the peasant community in exchange of gifts which were to be the property of the temple. The **Devdasi** system of Karnataka, in India, can be taken as a classic example of the working of this economy. The priest cannot become powerful inspite of so much polarization of wealth under him because the chastity concept has by now been elevated to the avowed level of purity for men as well. So a priest is unmarried and has no domestic production unit of his own. His sexual needs are granted within the religious framework by the system and yet the children of the **devdasi** do not lay any claim to the produce.

We have very little data on early peasants on this

aspect but it will not be difficult to assume that pagan Europe and also agricultural sites of Middle East must have developed similar institutions subsequent to the adoption of a full blooded settled economy. In India the evidence towards the emergence of settled village life provides certain interesting features. Reference to chastity or virginity, as would be expected, are altogether missing until about the beginning of Iron age, which is accepted by most archaeologist as belonging to the first half of the second millenium B.C. It is the earliest one can hope to go to get an impression of the personality of the society. Although no specifically pointed reference to chastity or virginity is made in this work, Sing (1978) going into detail to analyse the possible existence of incest, polyandry also *Niyog* (begetting child from a person other than the husband) in the *Vedic* society opines: "...the *Rigfeda* reveals the Aryans as a free and esay fun loving people, fully conversant with the uses or marriage, which they sanctify with due ritual and ceremony. We find evidence of great variety of conjugal relationships including monogamy, polygyny as well as polyandry". (page 56). The authors of *Vedas* who brought Aryan language to India did not settle down permanently at any place. They were pastoralists with a simple crop agriculture and there is no indication of a fullfledged intensification of cultivation demonstrable. The first post *Vedic* people who take to true peasant life are therefore the people who wrote the *Upanishads* and the *Puranas*. A true patriarchy with primegeniture rule of inheritance can also be traced to the post-*vedic* period. *Vedic* period most probably was, at least in the initial stages, a total matriarchal society (Kosambi, 1970). They used the hunters-gatherers both as slaves and also for sexual exploitation. The maize of mixed breed ranks were always kept apart with the power of brahminism. Even up to the time of *Purans* this sexual laxity is continued in a restricted form. "When, for example, the maiden Kunti invokes the sun god in her sprightly curosity, the latter, delighted, proposes coitus...Surya tells her that there would be nothing wrong in their act of love...it is none of her parents' or elders' business to

stop her". (Singh, page 78). Yet the same Kunti abandoned the child born in this process out of shame. That a transition towards developing a moral load or concept of chastity and virginity has set in, is evident. It can be seen in another passage in *Mahabharata* which refers to Madras as follows :

"Fathers, mothers, sons, mothers-in-law, fathers-in-law, maternal uncles, sons-in-law, daughters, brothers, grandsons and other relations, friends of the same age, guests, males, and female slaves, mix freely and without constraint ; and the women, according to their will, enjoy the company of men known and unknown...They drink spirituous liquor, eat beef, dance and giggle, and indulge in acts of sex without any inhibition whatsoever... Inebriated with spirits the women fling their clothes away and dance, and engage in unresticted sexual intercourse with whomsoever they will. How can their son, a Madraka, dare talk of "*dharma*" (Singh, pages 79-80).

The value load for chastity, virginity, drinking, unclothing and even giggling besides the avoidance of certain kins, or for that matter outsiders and slaves are all heavily loaded in this statement. The present scale of morality can, therefore, be undoubtedly traced to *Mahabharata* times. (If not early, at least during the late *Mahabharata* period). If archaeological sites associated with *Mahabharata* names are to be accepted as representing *Mahabharata* culture then we can say that till about 1000 B.C. which is represented by the Painted Grey Ware culture, a full-blooded cultivation was not adopted in the Gangetic plane. The Indus civilization, in this regard, remains a part of a totally different developmental process. It can be linked with the Middle East through trade and culture contact. For rest of India a slow and late adaptation of the changed socio-economic features seem to be indicative. Even then the amount of hunting implements found from Chirand a Neo-chalcolithic site in Bihar (2000 B.C.) would indicate the differential rate of this conversion to a full peasant society. In the absence of any other literature source we may consider *Ramayana* for enlightenment about the evolution of these values. It is believed to precede

the *Mahabharata* and, may, therefore, record the views of the late Vedic people. In this context the sexual overtures of *Surpanakha* appears more close to what could be accepted as normal than the fire purification test of chastity through which *Sita* is made to go through. In all probability, these values had to be added by later commentators when the strong patriarchal society with strict moral codes were established. Chakravarti (1983) and Chanana (1963) have developed these aspects of *Ramayana* much more explicitely. A peasant class, may not always have been a homogeneous social unit. There are always some very powerful, some less powerful and some least powerful. The tendency may have been for the most powerful to free himself from the demands of labour and provide various sanctions to the classes under him to lure them in doing the additional labour for his own benefit. These additional favours granted by the powerful peasants to the less powerful ones were always consolidated by marriage ties. In other words, class hypergamy in all likelihood may predate caste formation. Various hunting-gathering communities who had been brought under the peasantry at various times may have given rise to the caste groups in a later date. The quantum of marital favours sanctioned decided the stratigraphic position of the caste grups. The *varans* during the *vedic* times may have also had similar origin. In other words, we may have been looking at the history of caste formation from the other end of the tunnel and hence it will have to remain as a speculation. Castes are defined subsequent to the establishment of marriage distance between two communities tied within a corporate economic activity around cultivation. The central role in all these rules had been taken up by a group of learned people who were not unaware of social systems existing among the Nile, Euphrates and Tigris populations. These selected few kept their knowledge jealously guarded among themselves. Consequently they had the power of handling and organising large populations under their control. These people defined themselves as Brahmins and were the first to give up direct agricultural activities without

losing the benefit of the economy.

Late adoption of a full-blooded agriculture is best recorded in the extra Harappan zones in India. In south India occurs a cluster of sites designated as the Deccan Neolithic. These are recorded first around 1900 B.C. and continues to occur till 900 B.C.

At Tekkalkota (Karnataka) 19 remains of small circular huts with 3m. to 5m. diameter were discovered. These ranged in date from 1780 B.C. to 1540 B.C. and showed variation in the size of the structures. Small and big wooden posts are erected in some cases while in others no such post holes are seen. Natural boulders and rocks scattered on the surface has been taken advantage of to hold the structure. Remains of the floor and walls show thin lime plastering. Fire hearths and stone tools are found from within the huts and animal bones are found dumped in pits outside the huts. Burials are found under the floor of the house. Some bodies have been interned within urns. In Karnataka, Andhra and Tamil Nadu several more sites of almost identical date range yield similar Neolithic habitations. Brahmagiri, Sangankallu and Hallur in Karnataka, Piklihal in Andhra and Paiyampalli in Tamil Nadu are some of the well known sites among them. All these sites show rather scattered habitation with a fairly interesting ceramic content but otherwise with mainly microliths. Paddyya (1973) describes these habitations in detail. Neolithic axes or saddle and querns are not overwhelming in frequency. The ceramics is dull grey in colour and is hand made. The shapes, however, seem fairly exotic and do not match the personality of the culture. There are a variety of spouted vessels, some of them with hollow stands and low down external carination. After a very short duration of this pre-metal phase the culture enters metal age. Surprisingly the sites show no change either in habitation structure or the total material culture, although in one of the sites even a gold ornament is found. In fact if there is a change it is more towards a decline in ceramic variety. A true change indicating a more complex social organization is indicative only after the arrival of Iron.

Since culturally such an unchanged status in spite of the knowledge of a new and better technology is untenable one has to seek an alternate explanation for them. The size of the habitation and their nature of occurrence can be taken to indicate that these were relatively small hordes of Mesolithic hunters who settled around the rocky plains primarily because the lower region was exceedingly forested. The Inter Tropical Discontinuity bringing monsoon had caused heavy downpour twice a year along the coastal plain. The central rocky plain could not develop that dense a forest because of its rock base. The attempt to settle down by these hunter-gatherers was more of seasonal nature and they did not domesticate any seed crop for a long time. Their main carbohydrate source was from plants reproducing asexually, viz. Tapioka, yam, plantago and the like. Hunting provided the animal protein needed. Those among them who moved to the lower valleys did so on the power of both their large population and also the stone axe with which they could clear the relatively denser forests. Nagarjunakonda in Andhra and Navdatoli in the Malwa may be representing such break away branches who developed stable peasant villages. A third group whose pastoral economy is well demonstrated by the Ash mounds in Andhra may have had connection with the north-western region where bovids as domesticates occur from late Harappan times.

The ecology within which these people sought their adaptation was not the least conducive to the development of large scale agricultural settlements. Even today these regions of Karnataka receive less than 25 inches rainfall in a year. The tropical monsoon exhausts itself either in the western coast or the eastern coast (depending on the time of the year) and therefore an arid area develops around the region which is equidistant from both the coasts. These isolated grounds must have had relationship with each other based on either exchange or marriage. Any kind of warfare activity common in early settlers elsewhere seems to be not indicative. Cultivation of seed crop is recorded only around 1600 B.C. and here too such lentil crops are selected which require small patches of land

and can be grown with low rainfall. *Ragi* and *Hulgi* are the millets which are found commonly in them. Apparently this adaptation brought virtually no change in their demographic picture. Intensification and plough agriculture was not developed until the Megalith builders arrive as late as 600 to 800 B.C.

Most archaeologists in India have viewed this development or rather the lack of development as a case of isolation and stagnation. In view of whatever has been said it would be difficult to accept, in the first place, a Neolithic without socio-culture indicators of a proper peasantry and secondly to accept that a society virtually suffers no change even after the introduction of such an advanced technology of the possibility of metal using. Apparently no alternate explanation for this incongruity has been attempted because of the lack of conclusive evidences. It is my purpose to introduce here the possibility of these communities having entered a symbiotic relationship with early peasants no matter how much geographically separated they are. That we are in any way dealing with a period which has seen the rise and also the fall of one of the finest urban cultures with extensive trade roots in another part of the country further makes the probable contact of the Deccan Neolithic community with higher cultures in the north a strong possibility. Many experts have already opined such a direct or indirect contact to explain the ceramic types in the south. The Malwa-Jorwe group in the northern Maharashtra region (specially as demonstrated at Inamgaon) was well rooted in their peasant villages almost around the same time. So a contact either with the latter or indirectly with the late Harappans may not be entirely an impossibility.

The relationship of the forest group with the agricultural group can take various shades of expression. A purely economic contact for exchange is what the settled group ideally desires and to keep the process ongoing the peasants would like to see that the forest dwellers do not change their economy. For the forest people getting cereals in exchange of forest produce keeps him fed on the product of a different ecology and different technology. He enjoys

the fruits of an altogether alien system. Such a situation brings a negative scale of reference for each of the groups for the other. Therefore even technological import may not have any role in the cultural cognition of the forest dwellers. The imported objects of higher technology will have less utilitarian value within their world of activities. In the Deccan Neolithic the occurrence of gold toe ring would demonstrate the point I wish to make. This becomes specially significant when we compare this succession with the one known at Bagor (Rajasthan). At the latter site the Mesolithic folk tries to prepare copper arrow heads as soon as they have sufficiently evolved their culture. A toe ring, in this regard, is not just the thing to be desired by such a group of forest dwellers.

Another variety of contact occurs when the higher culture can afford to be indifferent to a soliciting group of forest dwellers because he has already overcome many of his needs of forest produce by some method or the other. Furthermore if the desirous forest group is already under a demographic pressure the bargaining power of the higher culture becomes manifold. The hunters in that case are content in being slowly accepted as a menial group with the main economic sphere of the peasants but at a much lesser benefit. Firstly they are kept out of the peasant social group. A physical distance may also be strictly maintained. Nonetheless, generations of this proximity can lead eventually to a menial caste formation. In other words, it is not only the total personality of culture of the two groups which determine their eventual nature of contact but also their ecological potential or limitations.

Introduction of plough and that too identified through back joints in cattle bones (Sahi, 1981) seem to occur fairly late in south India. Along with this comes the cultivation of such cereals as wheat and rice. The real changeover to peasantry, therefore, will appear to lie very late in India when compared with Asia minor. In the north the delay is caused by the apathy of the *Vedic* people towards settlement—a reason which falls mainly in the sociological realm, while in the south this delay is mainly caused by ecology. It is with the military invasion of the

Mauryans that a fullfledged urban society develops in this region. The effect of this arrival is adequately summed up by Habib (1982) :

> "The four *Varna* system of the legal theorists failed to be implanted in the south. The peasants were classed as *Sudras*, not *Vaisays*, an important index of the contemporary status of the peasants in India today... the *Jatis* came to be as firmly established in the south as anywhere else in India, possibly by wholesale conversions of the tribes. In such conversions *Brahmins* apparently played a crucial role...." (p. 19).

It is quite likely that the conversions were done initially by buddhist monks who eventually came to be regarded as Brahmins while the entire rest of the population became *Sudras*. A true *varna* system of the Vedic culture, therefore had very little implication in the forest dwellers. Among the *sudras* a distinction is made between the peasants and the menials (Ulavars and Vellalar in Tamil). The terms, mean the outsiders *(Vellalar)* and the cultivators *(ulavars)*—the latter by implication being the insiders. The reference of space here is mainly in terms of social distance.

The Deccan Neolithic sites represent the activities of both the *Vellalars* and *Ulavars* of which the former were the forest dwellers and the latter who had symbiotic relations with the former. Colonisers from north India were first in the form of Buddhist monks who provided an ideological framework to obtain allegiance from both these groups, *Karna's* reference to *Madrakas* cited earlier most probably refers to this period of symbiosis. It may, therefore, be not entirely correct to construct a Neolithic society under the Middle East pattern to explain most of the cultures outside Harappa zone in India and particularly for the Deccan Neoliths. What we are dealing with are complete forest tribes with vegeculture, millet cultivation in small plots and animal husbandry as subsistence economy. Considering that the population density in these groups were considerably low the social system can also be surmized as basically simple like in the Mesolithic period.

It is in this light that the explanation of 'centrepetal' marriage flow in the south Indian society would seem to be more congruous. A system with strong matriarchal sentiments inherited from the Palaeolithic period shifts into an economy which requires no surplus distribution or risk covering (by marriage alliance) which plagues cereal producers (mainly in dry cultivation). Consequently a system of consolidation within rather than alliance without is more likely to grow. Satisfying the materiarchal sentiments within a newly acquired patriarchy is best achieved by prescribed preferential marriage between cross-cousins. Further, such a system can help to direct constantly ramifying family branches towards a convergent line. Marriage of maternal uncle and niece prescribed in some restricted regions of south India almost prove the positive role of matriarchal sentiments discussed above. It will not be difficult to see the ultimate role of ecology in shaping an economy and then a given social system with this special example from south India.

An ecological interpretation of social structure in other areas of the world are by no means wanting (Sahlins, 1957 ; Barth, 1959 ; Dozier, 1961 ; Vayda, 1961 ; Fox and Cumberland, 1962 Meggitt, 1965 ; Netting, 1965 ; Harris 1966 ; Rappaport, 1967, Bhattacharya, 1972 ; Rutt, 1970 ; Berkner, 1972 and Basehart, 1973). A thorough study of these ethnographic works, which by no means are exhaustive, can go a long way to help the early historians see the areas of their generalizations. Peasantry, statehood and urbanization are phenomenon which are not predictable. Even if a variety of dependent attributes are identified a group may chose to adopt a strategy entirely different from what is expected. That is, the cultural personality of the group is as important as the ecology which is ultimately responsible for it.

6

Ecology and Fall in Civilizations

Archaeological evidences from almost all the prehistoric centres of civilization record a peak period of development marked by considerable increase in settlement area, construction of religious centres and elaborate burial customs. In some areas art proliferates and also uniform writing develops. In most of these early civilizations there is a common feature of increased trade activities which might also lead to the flourishing of the culture. Archaeologically this feature has been demonstrated by the gradual increase in the exotic luxury goods found in the cultural debris of a given civilization.

Death is the biggest tragedy in life. Man has always tried to fight this. The early civilizations also show extreme pre-occupation with deads and death as they had to learn a new that their newly acquired ability could win many of their earlier impediments but not death. Special burials is perhaps a way to rationalize death with beliefs of life after death. In Middle America and Mexico bizare practices of sacrifices were being practised by Aztecs and perhaps also their predecessors till about 16th century when Spanish colonisers reached these areas. Attempts of deriving life by killing numerous unfortunate members of the community are evidenced. Early records of the Spanish conquerors reported that Aztecs used to sacrifice by removing the heart while it is still beating and sometimes as many as 20,000 such killings were done in a day. Some groups of Nagas in the early years of this century were also known to have gone for head hunting with a similar belief structure. Groups of Amazon primitives and some tribes in Malayan Peninsula, New Guinea and Phillipines

likewise were believed to have such ritual killing practices till very recently. In prehistory one of the most spectacular examples of such a practice came from the Sumerians after the end of the Ubaid period (3800 B.C.). At the famous death pit at Ur. Sir Leonard Wooley reported some sixteen royal burials (Wooley, 1965). The queen in the one of these burials was put in a wooden bier. The entire upper part of her body was hidden by a mass of beads of gold, silver, lapis lazuli, carnelian, agate and chalcedony. Her head dress and other furnishings were lavishly orgnamented with gold, silver and jewels. Strewn around the chamber were human bodies which were apparently sacrificed for this special burial. There were remains of heavily jewelled chariots and jewel encrusted harp complete with the groom and a crowned harpist respectively. In one of these burials the excavator counted as many as eighty sacrificed bodies—as if to form a retenue of the departed king or queen for life after death.

Evidences like this at once indicate some important features of the society. This not only proves a ranked structure but also the right/power enjoyed by the individuals in the top of the rank ladder. He is not only contended with the entire surplus of the economy but uses the surplus to fulfil his needs in life (jewels) and also after death. His hold on the community must be very strictly defined with adequate ideological support so as to make his followers fulfil his desire even when he is dead. The bureaucratic structure maintains and executes the rulings of the leader. Most of these ancient civilizations had collapsed in the past because of the reason or the other. Archaeologists have tried to provide some explanation model for some of the specific cases. Since there is no compelling reason to believe that the cause of this collapse will be the same for all early civilizations, we may look into the available evidences in order to understand the role of ecology in them.

The Maya civilization is perhaps the only one which has received maximum attention towards this end. A symposium was held in Mexico to discuss the causes of the sudden collapse of the Maya lowland culture after

790 A.D. Willey and Shimkin (1971) have reported the main points evolved in this discussion. Most of the regions where this civilization developed is hot and semi-tropical forest land. A large number of volcanoes, sometimes over 400 meter in height, creates the high land zone. Volcanic ash and millennia of wind and water action has given rise to a thick layer of soil spread over the convoluted landscape of deep ravines, ridges and valleys. The tropical low land covers the immense area of the Pelen and the Yucatan peniusula. The rainfall in this region is seasonal and localized and hence can form severe droughts in case of rain failure. The vegetation is quite varied and contains a low thorny jungle cover. Humid mangrove forests interspersed with savanna and xerophytic scrub form the main floral characters. Deers, peccaries, tapirs, monkeys and turkeys are found in abundance. There are evidences of hunting-gathering communities wandering in this ecological setting from perhaps as early as 1500 B.C. The indication of the growth of this spectacular civilization is witnessed from around 200 B.C. The Mayan script may have developed only during the first century of the Christian era. The civilization had a stay of a little more than 900 years in total.

During the classic phase (between 300-700 A.D.) hundreds of beautiful pyramids, temples and other buildings were constructed. Simultaneously art, painting and sculpture also flourished to a stage of climax. However, unlike most of the other civilizations, the Mayans did not develop cities. Instead they lived in rual hamlets that was adjacent to their fields and sources of water. These dispersed agricultural hamlets were grouped around small ceremonial centres—i.e., a small temple pyramid and few other minor constructions. Some estimates show a marked population growth during the peak period. In bigger centers a population of as many as 50,000 individuals have been estimated. Obviously this represents a highly organized peasant group with a strong religious-cum-authoritarian structure. The surplus of the economy was more often than not used to consolidate the religious organization rather than to channelize it to improve the economy. They could main-

tain large cultivation with corporate and obligatory labour. The holy rulers were probably an exception in this regards. The sculpture, the artists, the metal technicians and probably also the writers were exempted from labour contribution in agriculture. The produce from the field was strictly distributed to individual households right from the field. With population increase the stress on subsistence has been met generally by bringing more land under cultivation. Thus, a generalized increase of the area occupied by the civilization is recorded in progressive phases. In terms of ceramic chronology the climax was reached between Tepeu 2 (8th century A.D.) and Tepeu 3 (9th century A.D.) horizons. When the volume of constructions in some regional centres for these two periods are estimated there is as much as 1/10 to about 1/100 decline. Art, ceremonialism and calendrics also attain their peak during Tepeu 2. It is also during this phase that the Maya socio-political structure attained its most complex development. This is reflected in the burial differences and also from the various artistic representations depicting elaborately costumed persons (dignitaries) interviewing persons of lesser status (petitioners). Again during this period there is a marked proliferation of multi-roomed buildings added to the ceremonial centers. All these evidences can be taken to indicate that during Tepeu 2 the Maya civilization was well established with hereditary aristocracy. It is evident that the civilization developed a statehood of a special kind wihout any attempt of creating urban metropolis. The bureaucratic group executing the only rulings for the peasants must have been drawn from the family of the ruler. The multiple roomed structures attached to the temples might represent the living quarters of these people. Further, trade even if present must have been more in the form of royal exchange and hence the need of developing an urban center was not felt by the Mayans.

A slight setback in the civilization is first recorded in A.D. 534. The practice of erecting dated stones or stolae in dedication to the deads act as a very good indicator in identifying this hiatus in A.D. 534. They recover from this

set back and continue to build various religious structures for another 230 years so as to reach a zenith by A.D. 770. Yet the crash came only 20 years after this peak. There was a rapid loss of lunar information and full calendrical termanology. This was followed by abandoning of big ceremonial centers. By about A.D. 830, a regionalism sets in the pottery with a marked decay in decoration. Simultaneously a new ceramic type invades the scene and rapidly takes over by about A.D. 950.

The case of this sudden collapse has been debated by the specialists for a long time. In the ecological-demographic sphere the cause could be a gradual intensification of agricuture to support the increasing growth of population. Intensification, if sought through new and more efficient technology may lead to further strengthening of the bureaucratic superstructure. In case this is met by increasing the area of cultivation, then it will require diverting progressively increasing man power to primary cultivation. Man power employed in non-agricultural activities as such is depleted. This can cause a generalized weakening of the social structure and finally the economic base. Assuming that the community has no possibility of having a technological answer to this stress not diverting more man power to intensification of agriculture can also create anarchy, starvation and economic crimes. In other words, either way there can be grave long running consequences. If this situation could be coupled with crop failure by over utilization, then the entire social-political system is threatened. There are evidences to show that trade with other communities was carried out by the Maya community for such products as salt and obsidian. A generalized lack of surplus can choke even this economic channel. Another important effect of an ever increasing population on the physical environment is to exceed exploitation beyond the environmental capacity of replacement. In areas of densest population even cooking fuel for the commoner might become scarce. Pressure on the forests and bogs and also on the denser human populations would increase the hazards of disease by way of insect vectors shifting to new hosts. Periodic epidemic of jungle yellow fever would be

an increasing threat as forest clearance disturbs monkey populations and other wild animal reservoirs of this disease. Accompanying these changes came the weakening of the socio-political system. The centralized temples and the rigid ritual structures around them prevented them from moving their habitations beyond a particular distance. Thus, the Mayans failed to develop a statehood with far-flung colonies tied with the central structure. The economic base also could not be developed beyond a limit, again for the same reason. In the neighbourhood of the Maya stronger civilizations with broad based social-political systems were already consolidating. Further the Mayan attempts to react or adapt to natural calamities were more religious than ecological. Hence the collapse, when it came, could not be prevented. In the event of such a disaster, the far-flung centers try to survive on their own with a smaller demographic unit. In the Maya this stage is marked by the decline of unifying cultural markers and consequently a number of regional forms emerge. However, these regional forms could not develop a strong enough social and ideological base to combat the invasion from outside and were eventually conquered. Thus, it will appear, that both for the **rise** as also for the **fall** of civilizations ecological-demographical factors are the two important causative forces. These in turn set off a chain of other socio-political changes. A successful adaptation to these processes makes the cultures grow and a failure to combat them can eventually cause a decline.

Evidences for the decline of the Aegean civilizations are better maintained in archaeological records. The volcanic eruption in the island Thera (110 km. off the north coast of Crete) destroyed much of Knossos around 1500 B.C. The civilization is again rebuilt by 1400 B.C. The decline of the Minoans at Knossos and other centers in Crete starts around this time. The Mycenaeans in the Greek main land were consolidating at this time in such famous centers as Pylos and Tiryns. It was not difficult for them to spread over into Crete to fill in the vacuum. We have numerous archaeological evidences to show volcanic destruction, repeated natural calamities like earthquakes, fa-

mines and wars. The Minoans had to fight wars off and on with the Greek mainlanders and this seems to have weakened the seat of the Crete civilization. The decline of the Aegean kingdoms, therefore, could be more because of the constant warfare than a direct failure to adapt to ecological changes. It is, however, very important to remember that most of these warfares seem to break up only when there are environmental calamities. Carpenter (1968) cites historical evidences from Hittites in Turkey having undergone an acute drought around 1200 B.C. It is likely that this drought was felt all over the near east and had caused repeated population dispersal to neighbourhood regions. That is, ecology did indirectly affect a decline in both the Minoans in Crete and the Mycenaeans in Greece.

The story of the Egyptian civilization is different. Here in pre-dynastic period (5200-3100 B.C.) a slow development of agriculture is witnessed along the Nile valley where it may have reached from further north western Mediterranean coast land (Libya). By late pre-dynastic period there is already evidence of a complex cultural structure developing. This would seem likely mainly because of the discovery of, as large as, sometimes 50,000 square meter settlement along the upper reaches of the Nile. In early dynastic period (3100-2686 B.C.) a minor official from upper Egypt called *Menes* (also known as Narmer) rose to power. He built the capital of Memphis and established a theocratic political system covering the entire navigable length of Nile. The written documents on papyrus paper from this period show that the culture was already endowed with the knowledge of astronomy, geometry, accounting, surgery and other arts and sciences. However, a complex bureaucracy, characteristic of statehood was not evolved at this stage. The succeeding dynastic kingdoms from 2686 to 2040 B.C. (First kingdom) and from 2040 to 1570 B.C. (New kingdom) show the slow rise of the absolute control of the monarch. Unlike Mesopotamia the Nile civilization did not develop standing armies, instead the number of administrators who were considered pious enough to share a chamber with the king after death, were increased in the time of prosperity. In

some regards the economy was more of a redistribution system than the typical serfdom observed in state formation.

There are, however, some periods within the span of these cultural phases when marked decentralization in administration is recorded. Under a new king or new religion the farflung centers were brought under the centralised structure. At about 1000 B.C. Egypt finally lost its military control over Nubia. This caused the break up of its Asiatic empire and finally culminated into the confrontation with Israel of David and Solomon. Peace could be brought temporarily by marriage of the pharaoh's daughter to Solomon but soon after the latter's death Jerusalem was plundered again and brought under Egypt's Asiatic empire. Around 525 B.C. Cambyses, a Persian king conquered Egypt and reduced it to a mere colony. In 332 B.C. Alexander the great evicted the Persian King and built the city of Alexandria. The rest of the conquest of this culure by Arabs and then the British are well known to history.

Freedom for life and material temptation, during the Old Kingdom, strictness in conformity during the Middle kingdom and military thurst during the New kingdom had their back lash in the Egyptian society. The economic base required high degree of gearing up to maintain the spate of constructions undertaken by such kings as Ramses II or to maintain such wars as Thut-Mose III of the Middle kingdom undertook. The political organization of the pharaohs suffered from the internal weakness of maintaining armies under the king to safeguard him and to take care of his immediate comforts. The economic base and the population of menials who manned it was left wide open. This was more because an internal revolt was not at all a possibility to the rulers after the first civil unrest at the end of the First Kingdom was successfully routed by clapping strict laws for the common man. Therefore, unlike Mesopotamia, where the rulers lived in fortified structures and from where they controlled the economic, social and religious matters of the whole community, the Egyptians developed a civilization on an open land and did not even